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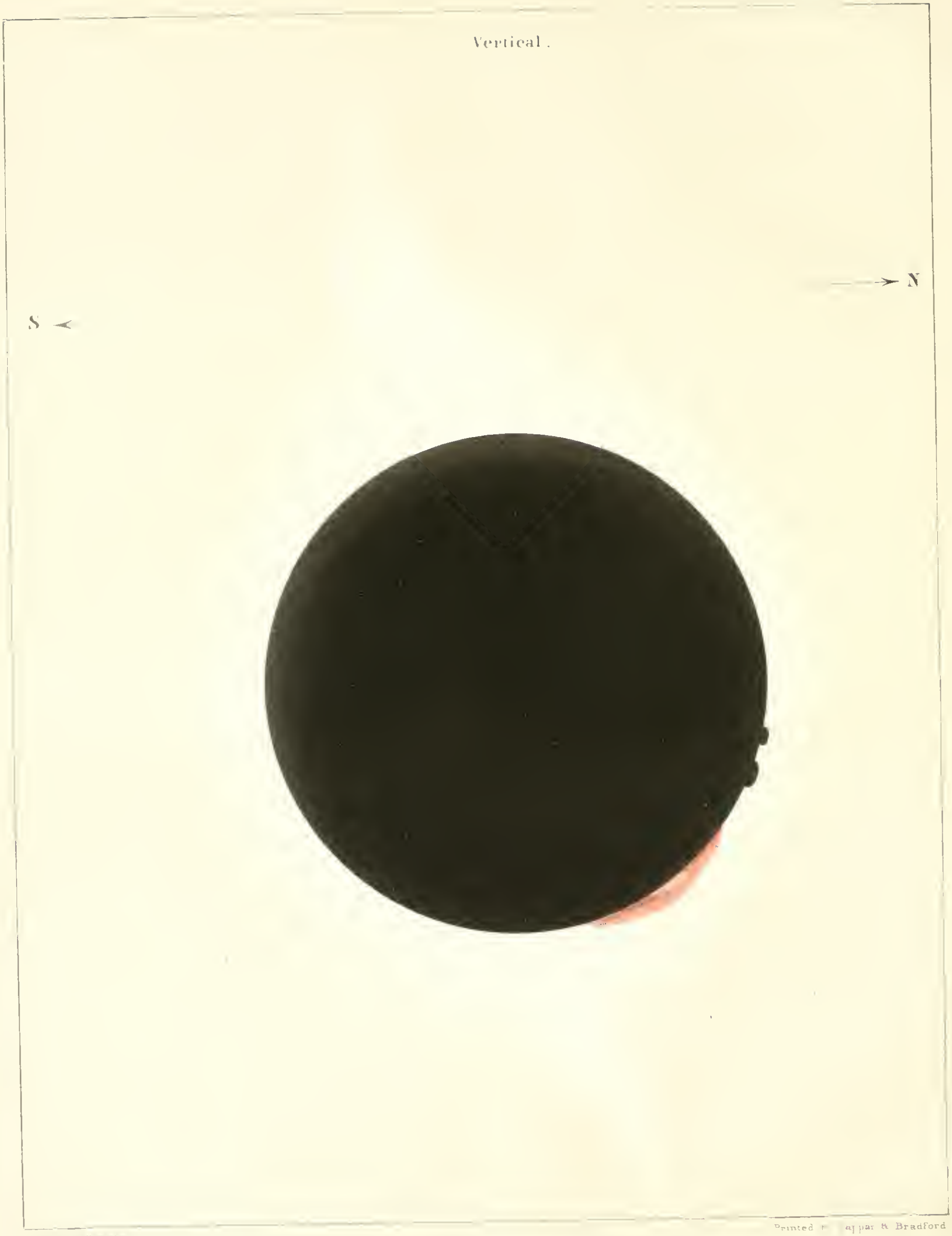

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EDITED BY

BENJ. APTHORP GOULD, Jr.,

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VOLUME III.

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THE

ASTRONOMICAL JOURNAL.

No. 49.

VOL. III. CAMBRIDGE, 1852, OCTOBER 23. NO. 1.

CONTINUATION OF INVESTIGATIONS RESPECTING THE ORBIT OF EGERIA.

By PROFESSOR J. S. HUBBARD,

OF THE WASHINGTON OBSERVATORY.

I HAVE found it convenient, in continuing the computations relative to *Egeria*, to adopt the equator as the plane of reference throughout. My Elements III. (¹) transferred to the meridian of Berlin, and assumed pure elliptic, thus become : —

M	299° 3′ 5″.33	1851, Jan. 1.0, M. T. Berlin.
$☊_0$	18 51 29.63	Mean Equinox, 1851.0.
ω_0	102 39 15.38	
i_0	37 10 33.66	
φ	4 52 49.392	
μ	14 18.0547	

I have computed, by the method of BRÜNNOW, (²) the perturbations produced by *Jupiter* and *Saturn* for intervals of 40 days, from 1850, November 2, to 1852, October 22. Integrating backwards and forwards from 1851, January 1, I found for the variations of radius-vector and argument of latitude, and for the coördinate $\{z\}$ which is the effect of perturbation perpendicular to the plane of the orbit, the following values, the unit of δr and $\{z\}$ being in the seventh decimal place : —

	δr	δu	$\{z\}$
1850, Nov. 2	+81.0	—0″.45	+16.7
Dec. 12	7.5	.06	1.8
1851, Jan. 21	5.9	.08	1.7
Mar. 2	38.1	.73	14.4
April 11	59.1	2.14	37.3
May 21	+ 20.9	4.20	67.7
June 30	—123.6	6.62	102.4
Aug. 9	—414.3	—8.89	+138.3
1851, Sept. 18	—878.9	—10″.31	+172.4
Oct. 28	1527.5	10.09	201.8
Dec. 7	2349.8	7.45	224.3
1852, Jan. 16	3313.0	—1.70	238.7
Feb. 25	4362.2	+7.61	244.9
April 5	5421.4	20.71	244.2
May 15	6395.1	37.51	240.3
June 24	7170.6	57.61	239.7
Aug. 3	7620.2	80.29	252.3
Sept. 12	7606.6	104.46	292.4
Oct. 22	—6992.0	+128.72	+379.3

Computing with the pure elliptic elements the values of r and u for 1852, October 22.0, and applying the perturbations for that date, I thence obtained for the coördinates referred to the equator and mean equinox of 1851.0,

$$\log x = {}_n0.2678495 \qquad \log y = {}_n0.2272454 \qquad \log z = {}_n9.8789990.$$

For the same date, I obtained by HANSEN's method, (³) for the variations of M, $\log r$, and the coördinate z perpendicular to the equator,

$$\delta M = +133''.503 \qquad \delta \log r = -1386.8 \qquad \delta z = +302.2$$

and hence for the coördinates,

$$\log x = {}_n0.2678497 \qquad \log y = {}_n0.2272455 \qquad \log z = {}_n9.8789990.$$

A year since, I had already computed by the old method, and with Elements II., the perturbations by *Jupiter* and *Saturn* for intervals of 42 days, from 1850, August 9, to 1851, December 16, taking into account the square of the disturbing force. Integrating these from 1851, January 3, the nearest epoch to that adopted above, to 1852, January 16, we find for the variations of the elements, and for the osculating system referred to the ecliptic,

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(¹) *Astron. Journ.*, Vol. II. p. 81.

(²) *Astr. Nachr.*, No. 808.

(³) *Ibid.*, Nos. 799, 800, 801.

$\delta M = -323''.162$	M	$29^\circ\ 32'\ 2''.96$	1852, January 16.0 M. T. Berlin.
$\delta\Omega = +\ 3.667$	Ω	$43\ 17\ \ 9.06$	Mean Equinox, 1851.0.
$\delta\omega = +111.029$	ω	$75\ 54\ 58.44$	
$\delta i = +\ 1.731$	i	$16\ 33\ \ 5.99$	
$\delta\varphi = -\ 35.057$	φ	$4\ 52\ 14.335$	
$\delta\mu = +\ 0.26845$	μ	$14\ 18.3231$	

Brünnow's method gives for the same date,

$$\delta r = -3313.0 \qquad \delta u = -1''.701 \qquad \{z\} = +238.7$$

and the coördinates are, by both methods,

	log x	log y	log z
1. By variation of elements,	$_n0.3191612$	9.8099191	9.9887680
2. By Brünnow's method,	$_n0.3191613$	9.8099231	9.9887717

giving for the effect of perturbation,

	Δx	Δy	Δz
1.	+.0002999	—.0000880	—.0001161
2.	3004	939	1245

as good a control as can be expected from computations made with different elements.

The constants for the computation of the coördinates referred to the equator and mean equinox of 1851.0 are,

$$\log a = 9.9915541 \qquad A = 105^\circ\ 13'\ 27''.77$$
$$\log b = 9.9140111 \qquad B = 23\ 12\ 13.27$$
$$\log c = 9.7812279 \qquad \omega_0 = C = 102\ 39\ 15.38$$

It is convenient, while applying the perturbations, to unite with them the reductions to the apparent equinox of the date, and this I have done by the method of Hansen. (¹) If ζ denote the annual luni-solar precession, ζ' the annual general precession, $\Delta\psi$ the nutation in longitude, and $\Delta\varepsilon$ the nutation of obliquity, and if, for *Egeria*,

$$\lambda = [9.79479]\,.\,\{\Delta\psi + t\,.\,\zeta\} + [9.72828]\,.\,\Delta\varepsilon$$
$$\lambda' = [4.30945]\,.\,\{\Delta\psi + t\,.\,\zeta\} - [4.31520]\,.\,\Delta\varepsilon + t\,.\,\{\zeta' - \zeta\}$$
$$\xi^* = -[3.91517]\,.\,\{\Delta\psi + t\,.\,\zeta\} + [4.78172]\,.\,\Delta\varepsilon$$

and

$$u = v + \omega_0 + \delta u + \lambda$$
$$x_1 = a\,.\,(r + \delta r)\,.\sin(A + u)$$
$$y_1 = b\,.\,(r + \delta r)\,.\sin(B + u)$$
$$z_1 = c\,.\,(r + \delta r)\,.\sin u\,,$$
$$\delta z_1 = [9.90134]\,.\,\{z\} + z_1\,.\,\xi\,,$$

then we have for the disturbed coördinates, referred to the apparent equinox of the date,

$$x = x_1 - y_1\,.\,\lambda' + [9.38940]\,.\,\delta z_1$$
$$y = y_1 + x_1\,.\,\lambda' - [9.85593]\,.\,\delta z_1$$
$$z = z_1 + \delta z_1.$$

Computing for intervals of 40 days the values of λ and of the corrections of x_1, y_1, z_1, I then obtained by interpolation the values of $r + \delta r$, u, Δx_1, Δy_1, and Δz_1, for each fourth day, and completed the calculation of the ephemeris in the usual manner.

The following table contains all the observations during the second appearance of *Egeria* that I have yet received, and the results of comparison with Elements III.

M. T. Berlin.	α	δ	C. — O. $\Delta\alpha$	C. — O. $\Delta\delta$	Place.	Authority.
1851, Nov. 26.82244 d.	173° 30′ 41″.5	+20° 57′ 17″.4	+ 2″.5	— 3″.3	Washington,	A. J., II. p. 185
28.88602	174 14 23.4	49 9.1	— 5.5	— 1.2	Washington,	" " 185
Dec. 1.82999	175 14 55.3	20 38 22.8	+ 0.9	+ 0.8	Washington,	" " 185
1852, Jan. 25.61487	186 25 45.9	21 1 13.2	+10.0	— 2.2	Durham,	Monthly Notices, XII. p. 133
28.58947	28 27.1	15 10.6	+10.2	— 5.8	Durham,	" " " 133
29.49271	28 16.8	19 44.2	+18.2	—14.9	Cambridge, Eng.,	A. N., XXXIV. p 47
30.56833	27 50.7	24 58.4	+10.0	— 7.9	Durham,	Monthly Notices, XII. p. 133
31.54287	26 46.2	29 54.4	+13.9	— 7.1	Durham,	" " " 133
Feb. 3.53891	20 39.7	45 36.4	+17.2	— 6.7	Durham,	" " " 133
.72222	20 4.2	46 38.9	+21.7	—10.2	Washington,	A. J., II. p. 185
4.54225	17 49.0	51 5.4	+ 6.2	—11.2	Cambridge, Eng ,	A. N., XXXIV. p. 47
5.61314	13 57.4	21 56 51.0	+10.5	— 6.3	Durham,	Monthly Notices, XII. p. 133
6.49714	10 25.2	22 1 51.3	+ 9.1	—14.6	Cambridge, Eng.,	A. N., XXXIV. p. 47
.59713	186 10 3.8	2 17.0	+ 4.8	— 7.1	Durham,	Monthly Notices, XII. p. 133
10.56859	185 49 2.1	24 33.9	+ 6.2	— 7.8	Durham,	" " " 133
13.58500	185 27 47.5	+22 11 38.7	+10.2	— 6.5	Durham,	" " " 133

(¹) *Ermittelung der absoluten Störungen, &c.*, pp. 79–81.

* The introduction of the factor $\frac{1}{\sin i_0}$ into the coefficients of the terms of ξ simplifies the calculation a little.

M. T. Berlin.	α	δ	C. — O.		Place.	Authority.
			$\Delta\alpha$	$\Delta\delta$		
d. 1852, Feb. 14.68549	185° 18′ 59″.9	+22° 47′ 52″.2	+ 8″.0	— 6″.0	Washington,	A. J., II. p. 185
17.55682	184 53 12.7	23 3 59.2	+11.1	— 9.1	Durham,	Monthly Notices, XII. p. 133
.65488	52 18.6	4 44.5	+ 8.4	—21.8	Washington,	A. J., II. p. 185
18.54896	43 21.3	9 20.1	+15.8	— 2.3	Durham,	Monthly Notices, XII. p. 133
19.41253	34 23.4	14 41.3	+21.8	—41.3	Hamburg,	A. N., XXXIV. p. 271
.58738	32 39.4	14 58.2	+15.0	— 1.4	Durham,	Monthly Notices, XII. p. 133
20.38942	24 1.2	19 20.1	+17.9	— 4.8	Hamburg,	A. N., XXXIV. p. 271
22.43475	0 54.4	30 5.2	+14.9	— 6.0	Hamburg,	" " 271
.45021	184 1 0.5	30 12.9	— 2.1	— 8.9	Berlin,	" " 181
23.37452	183 49 42.9	31 50.2	+13.9	— 3.6	Hamburg,	" " 271
.49369	48 15.4	35 32.6	+14.1	—10.1	Berlin,	" " 181
.58619	47 3.1	35 56.6	+19.0	— 6.0	Altona, Merid.,	" " 195
24.37771	37 21.2	39 53.8	+14.4	— 7.2	Hamburg,	" " 271
.44022	36 38.5	40 10.4	+10.2	— 5.5	Berlin,	" " 181
.57337	34 57.3	40 49.2	+11.0	— 5.0	Berlin, Merid.,	" " 183
.58292	34 42.1	40 51.5	+19.0	— 4.5	Altona, Merid.,	" " 195
25.36875	24 46.9	44 37.4	+13.9	— 2.0	Hamburg,	" " 271
.49288	23 14.6	45 16.6	+10.1	— 5.8	Berlin,	" " 181
.51222	22 57.1	45 21.5	+12.7	— 5.1	Durham,	Monthly Notices, XII. p. 133
26.32943	183 12 15.0	49 6.9	+13.7	+ 0.6	Königsberg,	A. N., XXXIV. p. 221
27.35972	182 58 31.9	53 54.2	+ 8.8	— 3.9	Hamburg,	" " 271
.55000	55 53.2	23 54 47.7	+12.2	— 6.1	Durham,	Monthly Notices, XII. p. 133
29.39707	30 11.1	24 2 42.9	+10.2	— 3.3	Hamburg,	A. N., XXXIV. p. 271
.56625	27 42.6	3 21.9	+14.1	— 3.3	Altona, Merid.,	" " 195
March 1.37200	16 11.1	6 38.7	+10.0	— 1.2	Hamburg,	" " 271
.56287	13 19.7	7 26.3	+15.1	— 3.5	Altona, Merid.,	" " 195
2.37165	182 1 26.3	10 37.8	+16.5	— 7.3	Berlin,	" " 181
.52840	181 59 8.8	11 9.9	+14.8	— 3.9	Durham,	Monthly Notices, XII. p. 133
.54718	58 49.9	11 2.8::	+17.0	+ 7.5	Berlin, Merid.,	A. N., XXXIV. p. 183
3.49826	44 36.4	14 43.8	+17.3	— 4.9	Durham,	Monthly Notices, XII. p. 133
.66286	42 11.6	15 14.9	+10.1	— 0.9	Washington,	A. J., II. p. 185
4.38462	31 12.0	17 45.9	+14.5	— 2.4	Hamburg,	A. N., XXXIV. p. 271
5.48041	14 19.8	21 28.5	+14.0	—10.7	Berlin,	" " 181
.53963	181 13 20.8	21 26.6::	+17.8	+ 2.4	Berlin, Merid.,	" " 183
7.62647	180 40 39.9	27 30.3	+ 8.0	+ 0.3	Washington,	A. J., II. p. 185
8.35582	28 51.2	29 24.1	+13.9	— 1.5	Hamburg,	A. N., XXXIV. p. 271
.45848	27 20.3	29 40.1	+ 8.9	— 2.4	Berlin,	" " 181
9.49902	180 10 33.9	32 4.9	+ 7.8	— 2.3	Durham,	Monthly Notices, XII. p. 133
10.66177	179 51 32.8	34 26.1	+12.8	— 0.9	Washington,	A. J., II. p. 185
11.50044	37 50.1	35 56.1	+10.5	— 0.6	Berlin,	A. N., XXXIV. p. 181
.51885	37 30.4	35 59.1	+12.1	— 2.1	Berlin, Merid.,	" " 183
12.35052	23 46.9	37 16.5	+13.7	— 1.6	Hamburg,	" " 271
.52897	21 3.9	37 31.2	+ 0.1	— 1.0	Durham,	Monthly Notices, XII. p. 133
13.36482	7 4.6	38 35.9	+ 9.9	+ 1.1	Berlin,	A. N., XXXIV. p. 181
.40052	6 21.3	38 39.7	+17.8	— 2.2	Hamburg,	" " 271
.51186	4 36.7	38 44.5	+11.6	+ 0.8	Berlin, Merid.,	" " 183
.52142	179 4 22.2	38 47.9	+16.7	— 2.0	Altona, Merid.,	" " 195
14.48870	178 48 21.3	39 40.0	+14.7	+ 4.1	Königsberg, Merid.,	" " 221
.51782	47 54.5	39 46.8	+12.6	— 1.2	Hamburg, Merid.,	" " 271
.51792	47 51.6	39 48.0	+12.4	— 2.4	Altona, Merid.,	" " 195
15.43719	32 38.6	40 24.3	+12.3	+ 1.6	Hamburg,	" " 271
.48519	31 47.9	40 27.2	+15.2	+ 0.1	Königsberg, Merid.,	" " 221
.51431	31 15.4	40 33.8	+18.6	— 4.7	Hamburg, Merid.,	" " 271
.51442	31 25.1	40 35.2	+ 8.8	— 6.1	Altona, Merid.,	" " 195
16.35629	17 25.3	40 51.0	+ 9.4	+ 1.0	Hamburg,	" " 271
17.40384	178 0 3.0	41 5.7	+ 8.5	— 1.6	Padua,	" " 237
.47818	177 58 42.1	41 4.6	+15.6	— 0.4	Königsberg, Merid.,	" " 221
.48815	58 39.3	41 5.1	+ 8.4	— 0.8	Berlin,	" " 181
.49784	58 26.1	41 5.7	+11.9	— 1.1	Berlin, Merid.,	" " 183
.50730	58 12.2	41 7.1	+16.4	— 2.8	Hamburg, Merid.,	" " 271
18.41268	43 20.2	41 5.9	+ 9.2	— 8.1	Padua,	" " 237
.47467	42 15.6	40 57.1	+12.3	— 0.2	Königsberg, Merid.,	" " 221
.48433	177 42 8.9	+24 40 57.8	+ 9.5	— 1.2	Liverpool,	Monthly Notices, XII. p. 133

M. T. Berlin.	α	δ	C. — O.		Place.	Authority.
			Δα	Δδ		
d.	° ′ ″	° ′ ″	″	″		
1852, Mar. 18.64553	177 39 28.0	+24 40 49.9	+10.7	+ 3.8	Washington,	A. J., II. p. 185
19.33100	28 11.1	40 35.9	+ 9.5	+ 0.5	Hamburg,	A. N., XXXIV. p. 271
.35530	27 52.5	40 48.8	+ 4.1	—13.1	Padua,	" " 237
.41501	26 50.7	40 33.8	+ 6.9	0.0	Berlin,	" " 181
.49084	25 32.1	40 31.0	+10.7	+ 0.2	Berlin, Merid.,	" " 183
.50030	25 19.1	40 29.9	+14.3	+ 1.0	Hamburg, Merid.,	" " 271
.50040	25 18.6	40 24.8::	+14.7	+ 6.1	Altona, Merid.,	" " 195
20.35549	11 21.5	40 0.5	+10.1	— 5.3	Hamburg,	" " 271
.37815	10 49.8	39 54.3	+19.2	— 0.3	Berlin,	" " 181
.46450	9 37.2	39 51.2	+ 7.4	— 1.5	Liverpool,	Monthly Notices, XII. p. 133
.49680	9 3.4	39 45.2	+ 9.5	+ 2.8	Hamburg, Merid.,	A. N., XXXIV. p. 271
.49691	8 57.3	39 48.3	+15.4	— 0.3	Altona, Merid.,	" " 195
.53170	177 8 32.1	39 45.4	+ 6.5	+ 0.8	Durham,	Monthly Notices, XII. p. 133
21.35087	176 55 4.9	38 57.5	+12.6	— 0.2	Hamburg,	A. N., XXXIV. p. 273
.40915	54 15.3	38 57.3	+ 5.5	— 3.9	Padua,	" " 237
.42854	53 50.4	38 51.7	+11.5	+ 0.3	Berlin,	" " 181
.48385	52 59.5	38 48.3	+ 5.1	— 0.1	Berlin, Merid.,	" " 183
.49330	52 45.3	38 48.2	+13.5	— 0.7	Hamburg, Merid.,	" " 273
.49342	52 39.1	38 49.1	+19.6	+ 4.3	Altona, Merid.,	" " 195
22.34418	39 3.5	37 40.3	+ 9.5	+ 1.5	Berlin,	" " 181
.35358	38 54.3	37 39.9	+ 9.6	+ 1.0	Hamburg,	" " 273
.36994	38 45.4	37 38.6	+ 2.7	+ 0.9	Padua,	" " 237
.46067	37 7.1	37 31.1	+13.4	+ 0.6	Königsberg, Merid.,	" " 221
.48035	36 54.6:	37 28.6	+ 6.8	+ 1.4	Berlin, Merid.,	" " 183
23.14513	21 47.5	36 0.4	—13.5	— 2.9	Liverpool,	Monthly Notices, XII. p. 133
24.34752	7 3.2	34 15.9	+12.3	+ 0.1	Hamburg,	A. N., XXXIV. p. 273
.37074	6 45.8	34 15.0	+ 7.7	— 1.8	Padua,	" " 237
.42688	5 58.6	34 4.6	+ 1.8	+ 1.8	Berlin,	" " 181
.47338	5 8.1	31 0.8	+ 8.3	— 0.1	Berlin, Merid.,	" " 183
.48285	5 7.9	34 8.9	— 0.4	— 9.4	Hamburg, Merid.,	" " 273
.49877	176 4 50.7	33 56.9	+ 1.7	+ 0.7	Durham,	Monthly Notices, XII. p. 133
25.33901	175 51 31.0	32 5.5	+11.5	+ 2.3	Hamburg,	A. N., XXXIV. p. 273
.47935	49 18.7	31 49.0	+12.7	— 0.7	Hamburg, Merid.,	" " 273
.47949	49 20.1	31 50.5	+11.1	— 2.2	Altona, Merid.,	" " 195
27.44332	19 13.4	26 39.1	+10.1	— 0.8	Königsberg, Merid.,	" " 221
.46299	18 57.9	26 35.4	+ 7.8	— 0.6	Berlin, Merid.,	" " 183
.47823	18 49.9	26 30.3	+ 2.0	+ 1.8	Durham,	Monthly Notices, XII. p. 133
28.31428	5 48.0	23 43.5	+ 4.5	+ 9.9	Hamburg,	A. N., XXXIV. p. 273
.46900	175 3 49.7	23 31.2	+12.9	— 3.2	Hamburg, Merid.,	" " 273
30.35074	174 36 39.0	16 49.1	— 6.9	+ 6.4	Hamburg,	" " 273
31.62648	174 18 22.0	11 52.6	+ 6.7	+ 2.2	Washington,	A. J., II. p. 185
April 2.39874	173 54 35.6	4 13.0	—22.4	— 1.0	Hamburg,	A. N., XXXIV. p. 273
.45194	53 19.9	3 57.6	—10.5	— 0.4	Hamburg, Merid.,	" " 273
.63300	50 55.9	24 3 7.8	+ 9.4	— 0.8	Washington,	A. J., II. p. 185
5.41185	173 11 52.4	23 48 53.5	+ 7.6	+ 6.1	Hamburg,	A. N., XXXIV. p. 273
7.65210	172 48 37.1	36 27.2	— 2.2	— 0.6	Washington,	A. J., II. p. 185
9.64668	26 25.4	24 3.2	— 5.2	+ 1.5	Washington,	" " 185
10.58225	172 16 27.3	23 17 57.6	— 1.0	0.0	Washington,	" " 185
13.57168	171 47 11.8	22 57 1.7	+ 1.9	+ 3.6	Washington,	" " 185
15.57434	171 29 43.0	22 41 59.4	+ 2.1	+ 2.1	Washington,	" " 185
23.58530	170 37 23.1	21 34 3.8	— 2.8	+11.1	Washington,	" " 185
24.69198	32 13.8	23 52.2	+ 5.8	— 5.7	Washington,	" " 185
25.58355	28 43.0	21 15 23.3	— 0.3	— 1.3	Washington,	" " 185
May 7.62931	12 57.1	19 11 59.2	— 4.3	— 6.1	Washington,	" " 185
10.68142	170 18 6.5	18 38 8.5	+ 6.5	— 0.8	Washington,	" " 185
20.68231	171 0 26.7	16 42 52.2	—41.2	—19.8	Washington,	" " 185
25.66703	171 33 1.6	15 42 41.0	+ 5.3	— 5.2	Washington,	" " 185
June 10.68494	174 7 31.8	12 23 55.9	+11.5	—23.8	Washington,	" " 185
July 8.60061	180 46 41.3	6 23 50.4	+ 2.8	— 9.4	Washington,	" " 185
9.60539	181 3 15.3	6 10 50.2	+ 9.0	—14.4	Washington,	" " 185
10.62062	20 10.0	5 57 36.9	— 2.3	— 2.5	Washington,	" " 185
11.60230	181 36 54.5	44 50.9	+ 1.2	—15.5	Washington,	" " 185
Aug. 1.59012	187 57 17.6	+1 11 24.8	+14.3	—25.9	Washington,	" " 185
7.59133	189 51 13.5	—0 6 9.1	+16.2	—37.9	Washington,	" " 185

The following normals may be taken as representing the observations at this second appearance of *Egeria* : —

M. T. Berlin.	α	No. Obs.	δ	No. Obs.	C. — O. $\Delta\alpha$	C. — O. $\Delta\delta$
	° ′ ″		° ′ ″		″	″
1851, Nov. 29.0	174 16 41.6	3	+20 48 43.0	3	— 0.7	— 1.2
1852, Feb. 13.0	185 32 12.7	37	22 38 19.5	35	+12.3	— 6.2
Mar. 16.0	178 23 17.8	52	24 40 41.9	52	+12.0	— 1.3
April 1.0	174 13 11.8	39	24 10 20.8	40	+ 5.3	+ 0.6
May 19.0	170 50 14.1	4	17 2 38.2	5	+ 5.0	—11.1
July 18.0	183 27 37.6	6	+ 4 21 25.9	6	+ 6.9	—17.6

OBSERVATIONS OF THE NINETEENTH ASTEROID,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury.]

[Corrected for refraction.]

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑲ — * $\Delta\alpha$	⑲ — * $\Delta\delta$	⑲'s apparent α	⑲'s apparent δ
1852	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Sept. 13	10 8 14.2	6	Weisse XXII. 13	+2 15.66	— 1 51.43	22 3 58.51	— 9 23 6.19
16	9 19 40.9	10	"	+0 17.83	—15 56.89	22 2 0.67	9 47 12.03
	9 43 6.6	4	Weisse XXI. 1375	+2 31.54	+ 6 41.21	22 2 0.69	9 47 13.42
17	9 8 18.5	10	"	+1 55.55	+ 2 17.44	22 1 24.69	9 51 37.02
18	9 19 30.1	8	"	+1 19.82	— 2 8.35	22 0 48.96	9 56 2.82
22	8 20 23.4	10	"	—0 13.78	—18 23.32	21 58 45.34	—10 12 17.91

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ
		h. m. s.	° ′ ″
Weisse XXII. 13	8	22 1 34.13	—9 32 3.20
" XXI. 1375	9	21 59 20.43	—9 54 42.24

SECOND COMET OF 1852.

Dr. Petersen writes that he had made a very considerable series of observations of this comet, but that the reduction of the observations had been delayed until the comparison-stars could be determined with the meridian-circle. Mr. Sonntag had computed new elements, and it is evident that the observations cannot be represented by a parabola. The elements seem to bear some slight resemblance to those of the comet of 1793, but appear hardly similar enough to warrant the supposition of identity.

Sonntag's elements are as follows : —

T	1852, October 11.33589 M. T. Berlin.	
π	42° 41′ 49″.1	Mean Equinox, Aug. 0.0.
☊	346 45 13.9	
i	41 43 2.0	
Log. q	0.1021432	
	Direct.	

They are computed from the observations, —

		Berlin M. T. Corrected for Aberration.	Geoc. α	Geoc. δ
		h. m. s.	° ′ ″	° ′ ″
Altona and Hamburg, 1852,	July 27	13 59 11.9	18 52 0.5	+3 3 57.5
Altona,	Aug. 17	12 7 45.4	21 48 40.8	21 51 41.7
Altona,	Sept. 7	10 15 1.3	30 49 22.7	+51 57 5.7

and represent the middle place thus : —

C. — O.

$\Delta\lambda = -2' \, 37''.0 \qquad \Delta\beta = -13''.2.$

COMET-CIRCULAR.

I HAVE received information from Dr. PETERSEN, that Professor SECCHI at Rome discovered, August 26, at 3½ A. M., while searching for Biela's Comet, a small nebulous comet in the Constellation of the Twins.

He writes to Dr. PETERSEN under date of August 26: “The comet when first discovered preceded by about $4^{s.}$ a small star *s* of the 9.10 magnitude; and at $3^{h.}$ $52^{m.}$ it covered the star exactly with its center, so that the comet could only be recognized by the circumstance that the star seemed enveloped in a faint nebulosity. Half an hour later, the star appeared free from the comet, and we made some comparisons; but as the twilight had commenced, the comet appeared extremely faint, and these observations are not reliable. The position of the star *s* was determined with the ring-micrometer, by comparison with *Hist. Cél.* 14,637.

$$\alpha = \text{Lal. } \alpha + 5^{m.}\ 43^{s.}.6\ ;\quad \delta = \text{Lal. } \delta + 5'\ 20''\ ;$$

which measurements will serve to identify the star.

“Assuming for the position of the comet that of the star *s* at the instant of the central occultation, we shall find,

1852.	M. T. Rome.	☄ α	☄ δ
	h. m.	h. m. s.	° ′ ″
Aug. 25	15 52	7 29 31.4	+21 48 37

“The approximate hourly motion deduced from all the observations would be $+12^{s.}$ in α, and $-115''$ in δ (somewhat uncertain).

“The result of the best observations made subsequently is,

1852.	M. T. Rome.	☄ α	☄ δ
	h. m. s.	s.	″
Aug. 25	16 14 5	*s* +3.85	*s* —42

“I do not know whether this is a new comet or a portion of BIELA's which was divided in the beginning of 1846. The difference between this position and that given by the ephemeris is very great.”

Dr. PETERSEN considers the new comet to be undoubtedly BIELA's, and remarks that the observed position, although varying much from Professor SANTINI's ephemeris, lies very near the orbit of the comet, and the hourly motion observed is not inconsistent with that of Biela's comet.

I cannot but agree with Dr. PETERSEN's views, as the observed place is almost directly in the geocentric path of the comet of BIELA. It is earnestly to be hoped that it may not yet be too late for some one of our large American telescopes to furnish another observation of this remarkable object, as no other instruments of sufficient power are in equally favorable geographical positions. But this can perhaps hardly be expected, as the comet's nearest approach to the earth occurred about September 6. I add for convenience of reference the positions given by the ephemeris of SANTINI for the time of Professor SECCHI's observation.

Mean Noon Greenwich.	☄ α	☄ δ
1852, Aug. 23	104° 2′ 39″.5	+21° 21′ 19″.4
25	106 47 5.0	23 42 33.7
27	109 31 25.7	+23 0 30.0

Professor SECCHI subsequently obtained farther observations as follows:—

1852.	M. T. Rome.	☄ α	☄ δ
	h. m s.	s.	′ ″
Aug. 27	15 46 11	*b* +13.36	*b* — 9 39.15
28	16 15 35	*c* +13.26	*c* + 1 36.4
Sept. 1	16 15 9.6	*d* —25.13	*d* —18 45.6

Comparison-Stars.

b	B. Z. 279	$7^{h.}$ $38^{m.}$ $21^{s.}.91$
d	H. C. No. 16,130	
c	was compared with ∗ B. A. C. 2632,	

$$c\,\alpha = *\,\alpha - 1^{m.}\ 28^{s.}.7 \qquad c\,\delta = *\,\delta + 17'\ 31''.$$

Cambridge, 1852, *September* 24.

G.

LETTER FROM MR. VALZ TO DR. PETERSEN.

Marseilles, 1852, *September* 22.

I HAVE the honor to inform you of the discovery of a new planet, made by Mr. CHACORNAC while working for the completion of the ecliptical charts, of which I communicated the plan to the Institute in 1847, upon the preparation of which I have since been occupied, and which I hope will soon be published.

During the night of September 20, Mr. CHACORNAC of Marseilles discovered a star of the 9 magnitude in a place where he had not seen any star previously. Between $10^{h.}$ $50^{m.}$ and $15^{h.}$ $30^{m.}$ its right-ascension diminished by 10 seconds of time. At $12^{h.}$ $2^{m.}$ M. T., it preceded 449 of LALANDE's Catalogue by $4^{m.}$ $54^{s.}$, and was farther south by 9′ 45″. These distances had become $5^{m.}$ $4^{s.}$ and 10′ 45″ at $15^{h.}$ $57^{m.}$ M. T.

Referring to previous positions, Mr. CHACORNAC found an observation made September 9 about midnight, of a star of the 9 magnitude which was no longer to be seen, and which he believes to have been the same, and a planet. Its position was,—

$$\alpha = 5°\ 4'\ ;\quad \delta = +2°\ 40'.$$

September 21, $10^{h.}$ $40^{m.}$ the new planet preceded 44 *Piscium* by $7^{m.}$ $28^{s.}$, and was farther north by 33′ 15″.

Mr. CHACORNAC having left at my disposal the name to be given to this planet, I proposed that of *Massalia*, with the symbol ⑳ of the order of the discovery.

BENJ. VALZ.

LETTER FROM DR. PETERSEN TO THE EDITOR.

Altona, 1852, *September* 28.

I HAVE but a moment's time to inform you that Professor SECCHI in Rome has discovered the companion of Biela's Comet also, following the principal portion at the distance of about half a degree.

With this I send Professor SECCHI's letter containing his remarks and observations.

Professor ENCKE of Berlin has also sent me an observation of Biela's Comet.

1852.	M. T. Berlin.	☄ α	☄ δ
	h. m. s.	° ′ ″	° ′ ″
Sept. 17	15 45 16.7	111 32 4.9	+10 50 55.8

I am earnestly hoping that this most interesting comet may be followed in America for a time with the great refractors.

The apparent positions of Mr. CHACORNAC's new planet as deduced from his observations are, —

1852.	M. T. Marseilles.	⑳ α	⑳ δ	
Sept. 9	12h.	5° 4′	+2° 40′	Estimated.
	h. m.	h. m. s.	° ′ ″	
20	12 2	0 11 11	1 45 53.8	
	15 57	0 11 1	1 44 53.8	
21	10 40	0 10 23.03	+1 40 45.4	

Mr. CHACORNAC only gives the differences to entire seconds, and the foregoing places noted to hundredths of seconds result from rigorous computation of the positions of the comparison-stars, — which SONNTAG has assumed to be,

	* α	* δ	
	h. m. s.	° ′ ″	
Sept. 20	0 16 5.11	+1 55 38.8	H. C. 419
21	0 17 51.03	+1 7 30.4	44 *Piscium.*

A. C. PETERSEN.

This twentieth asteroid has been observed by Mr. FERGUSON at Washington as follows: —

1852.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑳ — * Δα	⑳ — * Δδ	⑳'s apparent α	⑳'s apparent δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Oct. 19	9 4 18.3	12	Weisse XXIII. 1039	—3 29.11	—4 50.53	23 47 3.78	—1 1 53.84
20	8 8 15.2	8	"	—4 2.98	—8 53.66	23 46 29.90	—1 5 41.30

Adopted Mean Place, for 1850.0, *of Comparison-Star.*

* α	* δ
h. m. s.	° ′ ″
23 50 24.315	—0 57 43.40

Mr. FERGUSON estimates the star at the 8.7 magnitude.

G.

LETTER FROM PROFESSOR SECCHI TO DR. PETERSEN.

Rome, 1852, *September* 16.

I HAVE the pleasure of announcing to you that I found this morning the other portion of Biela's Comet. It was very faint, without a nucleus, and of an elongated ovoid form, the apex being turned away from the sun. It followed the other part at a distance of about two minutes of time, and was about half a degree farther south. The extreme faintness of this second portion, and my fear of losing the observation of the other, did not permit me to make a better observation.

The position found for the first and previously observed part of the comet, obtained by five comparisons with a small star of the 10 magnitude is,

1852.	M. T. Rome.	☄ α	☄ δ
	h. m. s.	s.	″
Sept. 15	16 13 58.4	* —19.2	* —53.2

For the position of the star I have only been able to make one observation, by comparison with ξ *Leonis.* The result is,

	Δα	Δδ	
ξ — *	+7m. 7s.2	+16″	about.

I believe this result will be sufficiently exact for the identification of the star.

These observations are very difficult with our instrument, for even when the comet has been found it is with difficulty that the star can be recognized; and the time for observation is very short, for the comet hardly rises above the vapor of the horizon before it is enveloped by the twilight. I hope that those who possess better instruments will have the goodness to fix the positions of the stars, for I have always been careful to determine the comet's place well relatively to one of the small stars in the vicinity.

The principal part of the comet did not continue to appear of the same figure as at first. It looked quite irregular and had two very faint streaks; it was more luminous in the center, but without any nucleus.

A. SECCHI.

NEW WORKS.

1. *Astronomical Observations made at the Observatory, South Villa, Regent's Park, London.* — Mr. Bishop, the founder and proprietor of the London Observatory, so well known to the astronomical world as the place where Mr. Hind has detected many previously unknown members of our system, has recently published in a beautiful volume the series of astronomical observations made during the years 1839–1851.

After a description of the Observatory is a catalogue of observations of double-stars, which is followed by a history of researches and observations upon double-stars, and a series of historical and descriptive notes; the latter constituting a large portion of the volume. The remainder of the work consists of the observations of newly discovered planets and comets.

The volume forms alike a noble monument to the public spirit of Mr. Bishop and the eminent attainments and unwearied zeal of Mr. Hind.

2. *Mr. Bishop's Ecliptical Charts.* — These charts have been prepared as a means of searching for undiscovered planets, and with the view of enabling astronomers easily to identify stars of a smaller class than those found on other maps. It is by their aid that Mr. Hind has been enabled to add so largely to the number of the known asteroids, and to detect so many missing and variable stars.

Mr. Bishop states that his series will comprise twenty-four charts, one for each of the hours of right-ascension, — and exhibiting all the stars to the eleventh magnitude inclusive, within 3° on each side of the ecliptic. The stars of the *Histoire Céleste* and *Bessel's Zones* have been used as reference points, and the other stars mapped in by comparison with these. About 15,000 stars have been observed in this way within the last two years.

Hours I., II., III., IV., VII., X., and XIII. of the series are now published. Seven more Hours are, as Mr. Bishop informs us, in a state approaching completion.

3. *Annals of the Astronomical Observatory of Georgetown College.* — Under this title Professor Curley of Georgetown has published the first volume of a series, designed to contain the observations to be made at the Georgetown Observatory. The present volume contains a history and description of the Observatory, together with a description of the construction and use of the transit-instrument and meridian-circle adapted for the instruction of youth. The latitude and longitude of the Observatory as given by Professor Curley are, — Latitude, $+38° 54' 26''$; Longitude, $5^{h.} 8^{m.} 18^{s.}.2$ west of Greenwich.

G.

NOTICE.

The package of recent volumes of the *Astronomische Nachrichten* referred to in Dr. Petersen's letter of August 24 (A. J., II. 188) has been received, and the books are now ready for those astronomers who desire them.

G.

CORRECTION.

Professor Hubbard communicates the following corrections to Dr. Brünnow's paper on the computation of special perturbations, *Astronomische Nachrichten*, No. 808.

Page 261, line —8, *for* $\cos \frac{1}{2} J \sin \frac{N - \text{☊}'}{2}$, *read* $\cos \frac{1}{2} J \sin \frac{N + \text{☊}'}{2}$.

" " line —7, *for* $\cos \frac{1}{2} J \cos \frac{N - \text{☊}'}{2}$, *read* $\cos \frac{1}{2} J \cos \frac{N + \text{☊}'}{2}$.

" " line —4, *for* $w^2 s Z + \frac{k^2 \omega^2}{r_0^3} z_0$, *read* $w^2 s Z - \frac{k^2 \omega^2}{r_0^3} z_0$.

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THE SEMIDIAMETERS OF VENUS AND MARS INVESTIGATED

FROM THE OBSERVATIONS MADE WITH THE MURAL-CIRCLE OF THE NAVAL OBSERVATORY AT WASHINGTON, DURING THE YEARS 1845 AND 1846.

By BENJAMIN PEIRCE, LL. D.,
PERKINS PROFESSOR OF ASTRONOMY AND MATHEMATICS IN HARVARD UNIVERSITY.

Venus and *Mars* are peculiarly adapted, by their great changes of distance from the earth, for deciding the question whether there is any constant increase of the apparent disc of a planet above its real magnitude, by irradiation, thickness of wire, or any other cause. It must be admitted, that there are some things necessarily connected with the observation of these planets which may sensibly modify their bearing upon this investigation. The greatest apparent diameter of *Venus*, for instance, is observed when the disc is reduced to a fine line, whereas it is full when the diameter of its disc is least; and with *Mars*, on the other hand, the greatest disc is observed at midnight, and the least disc when it is in the vicinity of the sun. The results of the following researches seem to me, however, to prove that these circumstances are not sufficiently adverse to vitiate the investigation.

Let $A =$ the constant quantity by which the measured apparent semidiameter is enlarged by irradiation, thickness of wire, or otherwise;

$\delta\,\sigma =$ the correction of the mean apparent semidiameter at the unit of distance estimated in parts of itself as the unit;

$\sigma =$ the computed semidiameter at the time of observation;

$\sigma' =$ the observed semidiameter;

and each observation gives the equation,

$$A + \sigma\,\delta\,\sigma = \sigma' - \sigma.$$

The combination, by the method of least squares, of all these equations corresponding to the various observations of the semidiameter of *Venus*, made at the Washington Observatory with the mural-circle during the year 1846, gives the final equations,

$$\begin{aligned} 30\,A + 328''.8\;\delta\,\sigma &= 28''.95 \\ 328.8\,A + 4669\;\delta\,\sigma &= 357.2 \end{aligned}$$

from which we obtain,

$$\begin{aligned} A &= 0''.554 \pm 0''.107 \\ \delta\,\sigma &= 0.0375 \pm 0.0086 \end{aligned}$$

The probable error of an observation $= \pm 0''.280$.

In the same way, the combination of all the equations for the various observations of the semidiameter of *Mars*, made at the Washington Observatory with the mural-circle during the years 1845 and 1846, gives the final equations,

$$\begin{aligned} 43\,A + 284''.94\;\delta\,\sigma &= 65''.45, \\ 284.94\;\delta\,\sigma + 2234.5\;\delta\,\sigma &= 482.1. \end{aligned}$$

The solution of which gives,

$$\begin{aligned} A &= 0''.596 \pm 0''.167, \\ \delta\,\sigma &= 0.1397 \pm 0.0257. \end{aligned}$$

The coincidence between these two values of A seems to be sufficient to warrant the conclusion, that the value of this constant is the same for each of these planets, and its smallness indicates that it is solely attributable to the thickness of the wires. By supposing it to be the same for both planets, and writing σ_1 for the apparent semidiameter of *Mars*, to distinguish it from that of *Venus*, the final equations become,

$$\begin{aligned} 73\,A + 328''.8\;\delta\,\sigma + 284''.94\;\delta\,\sigma_1 &= 94''.40 \\ 328.8\,A + 4669\;\delta\,\sigma \qquad\qquad &= 357.2 \\ 284.94\,A \qquad\qquad + 2234.5\;\delta\,\sigma_1 &= 482.1 \end{aligned}$$

the solution of which gives,

$$\begin{aligned} A &= 0''.575 \pm 0''.111 \\ \delta\,\sigma &= 0.0360 \pm 0.0099 \\ \delta\,\sigma_1 &= 0.1425 \pm 0.0167. \end{aligned}$$

It may, perhaps, be thought preferable, in the combination of the observations of *Mars* and *Venus*, to have regard to the difference of the probable error of observation in the two cases. By combining them in this way, I obtain the final equations,

$$\begin{aligned} 41.709\,A + 328''.8\;\delta\,\sigma + 97''.46\;\delta\,\sigma_1 &= 51''.338 \\ 328.8\,A + 4669\;\delta\,\sigma \qquad\qquad &= 357.2 \\ 97.46\,A \qquad\qquad + 764.4\;\delta\,\sigma_1 &= 164.91. \end{aligned}$$

The solution of which gives,

$$\begin{aligned} A &= 0''.565 \pm 0''.121 \\ \delta\,\sigma &= 0.0367 \pm 0.0101 \\ \delta\,\sigma_1 &= 0.1437 \pm 0.0203. \end{aligned}$$

The final result of the correction gives for the vertical semidiameters of these two planets at the mean distance of the earth from the sun,

The vertical semidiameter of *Venus* = 8″.546 ± 0″.086
" " *Mars*, = 5.055 ± 0.101.

The details of the several observations are contained in the following table, in the last column of which are given the residual excesses of observation above the diameter obtained by means of the preceding correction, and increased by the constant *A*.

Observations of the Semidiameter of

VENUS.

Date of Observation. 1846.	σ	$\sigma' - \sigma$	Residual Excess of Observation above Theory.
Jan. 8	15″.35	+0″.49	—0″.63
22	18.79	1.70	+0.45
23	19.08	1.60	+0.34
24	19.38	1.02	—0.26
26	19.99	1.02	—0.28
28	20.63	1.59	+0.27
April 2	20.42	0.89	—0.43
8	18.53	1.32	+0.08
17	16.14	1.04	—0.11
20	15.44	1.26	+0.13
21	15.23	1.72	+0.60
24	14.60	0.93	—0.17
26	14.21	0.85	—0.23
July 12	7.04	1.64	+0.83
15	6.92	1.50	+0.69
19	6.77	1.10	+0.30
30	6.39	0.74	—0.05
Aug. 3	6.28	0.54	—0.45
4	6.25	0.89	+0.11
5	6.22	1.23	+0.45
6	6.19	0.68	—0.10
11	6.06	0.94	+0.16
17	5.92	0.30	—0.47
Sept. 4	5.56	0.80	+0.04
6	5.52	0.64	—0.12
15	5.38	0.56	—0.19
24	5.26	0.23	—0.52
28	5.22	0.24	—0.51
Oct. 5	5.14	0.25	—0.49
9	5.10	+1.24	+0.50

MARS.

Date of Observation.	σ	$\sigma' - \sigma$	Residual Excess of Observation above Theory.
1845, May 10	6″.28	—0″.71	—2″.18
July 18	10.23	+2.00	—0.02
31	11.20	3.25	+1.09
Aug. 4	11.51	2.01	+0.20
7	11.61	1.58	—0.64
11	11.77	2.39	+0.24
12	11.80	2.23	+0.08
13	11.82	2.32	+0.17
23	11.83	2.85	+0.70
31	11.51	2.58	+0.38
Oct. 7	8.30	0.70	—1.05
15	7.55	3.51	+1.86
17	7.48	2.65	+1.00
18	7.41	1.13	—0.50
19	7.34	1.60	—0.02
21	7.25	1.02	—0.59
22	7.18	2.29	+0.69
23	7.11	0.75	—0.84
24	6.95	1.19	—0.28
31	6.46	1.17	—0.33
Nov. 5	6.15	0.95	—0.50
13	5.70	0.27	—1.12
15	5.57	2.06	+0.69
21	5.29	2.17	+0.84
22	5.24	0.67	—0.66
24	5.13	1.09	—0.22
25	5.08	1.14	—0.17
28	4.94	2.10	+0.81
Dec. 2	4.77	1.00	—0.26
6	4.61	1.37	+0.13
9	4.51	1.15	—0.06
10	4.49	0.41	—0.80
11	4.46	1.73	+0.52
12	4.44	1.91	+0.71
16	4.24	0.79	—0.40
20	4.11	1.65	+0.48
27	3.88	1.72	+0.58
1846, Jan. 5	3.65	1.37	+0.26
8	3.57	1.40	+0.30
22	3.24	1,33	+0.27
26	3.16	1.14	+0.10
28	3.12	0.58	—0.35
Feb. 3	3.00	+0.84	—0.18

OBSERVATIONS OF MELPOMENE,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury.]

[Corrected for refraction.]

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑱ — *		⑱'s apparent		A.
				$\Delta\alpha$	$\Delta\delta$	α	δ	
1852.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
July 27	10 55 9.8	16	B. A. C. 6049	—0 52.15	—10 28.57	17 43 59.95	—11 2 1.84	10
	11 44 54.5	5	"	—0 53.24	—10 44.02	43 58.86	2 17.69	10
28	8 50 21.3	5	"	—1 18.78	—16 50.55	43 33.40	8 23.79	10
	9 18 38.6	10	"	—1 19.47	—16 58.30	43 32.71	8 31.54	10
	9 45 33.7	5	"	—1 20.16	—17 6.84	43 32.01	8 40.08	10
Aug. 1	10 0 51.2	10	Weisse XVII. 810	+1 1.83	—19 57.17	41 54.28	37 5.86	10
	10 35 38.1	4	"	+1 1.38	—20 7.68	41 53.83	37 16.51	10
2	10 10 22.6	10	*a*	+0 15.64	+ 6 21.67	41 35.81	44 25.37	10
3	9 49 14.6	3	Weisse XVII. 834	—0 50.39	+15 4.45	41 18.01	51 38.38	9
	10 17 9.6	10	"	—0 50.62	+14 55.43	41 17.78	51 47.41	9
(1)	10 39 27.8	4	*a*	—0 1.73	— 0 52.25	41 18.44	11 51 39.27	9
6	9 30 16.7	10	Weisse XVII. 834	—1 30.58	— 6 54.84	40 37.79	12 13 37.61	10
	10 11 8.2	9	" 834	—1 30.88	— 7 9.42	40 37.49	13 52.20	10
7	10 48 58.5	7	" 834	—1 40.66	—14 44.50	40 27.70	21 26.79	10
12	9 59 38.6	11	" 835	—1 59.90	— 5 32.18	40 12.52	12 58 44.53	7
13	9 11 0.8	10	" 835	—1 56.95	—12 48.56	40 15.47	13 6 1.88	7
14	9 27 41.7	14	" 787	+0 36.22	+19 14.93	40 20.95	13 33.35	10
15	9 14 51.6	20	" 787	+0 43.19	+11 45.15	40 27.87	21 4.25	8
17	11 16 35.3	11	" 787	+1 4.54	— 3 56.74	40 49.12	36 45.09	8
18	8 54 26.2	12	" 787	+1 16.62	—10 45.39	41 1.18	43 33.76	10
	9 43 33.8	4	" 787	+1 16.92	—10 59.62	41 1.48	43 47.99	10
19	8 18 11.9	3	" 856	—1 56.32	+ 4 18.50	41 16.36	50 58.35	10
	8 37 45.5	12	" 846	—1 32.76	+ 3 45.60	41 16.41	13 51 4.33	10
26	8 34 7.9	15	" 867	+0 21.95	+15 48.28	44 0.07	14 42 56.60	10
29	7 52 2.9	2	" 867	+1 59.93	— 5 51.65	45 38.04	15 4 37.17	10
		2	" 966	—2 14.15	+ 4 22.42	45 38.49	4 47.08	10
	10 25 48.1	5	" 867	+2 3.43	— 6 35.93	45 41.54	5 21.65	10
		5	" 966	—2 10.93	+ 3 37.90	45 41.72	5 31.59	10
30	9 40 38.4	10	" 966	—1 35.19	— 3 20.08	46 17.64	12 29.57	10
31	8 13 49.9	20	" 966	—0 58.96	—10 5.32	46 53.85	19 11.81	10
Sept. 1	8 22 27.2	10	*a′*	—0 20.72	— 8 42.98	47 34.85	26 24.79	10
2	8 23 9.1	10	B. A. C. 6065	+0 26.95	+13 22.08	48 16.88	33 32.05	10
	9 35 58.4	4	"	+0 29.02	+13 6.08	48 18.95	33 48.06	10
5	7 55 23.2	10	"	+2 43.55	— 7 21.70	50 33.42	51 15.75	10
	7 53 37.3	9	Madras 1209	+2 14.00	—14 50.00	50 33.64	15 54 11.45	10
(2) 7	7 50 41.9	12	*b*	+0 36.06	— 9 17.42	52 13.36	16 7 53.25	10
		12	Lalande 32986	—1 26.08	+ 5 10.98	52 13.40	7 53.29	10
13	7 44 55.9	14	" 33178	—0 45.37	— 7 17.50	17 57 55.44	16 46 14.85	8
16	8 6 23.6	10	" 33098	+5 5.29	— 4 1.27	18 1 9.02	17 5 50.72	10
17	7 38 20.2	15	*d*	+0 4.66	— 1 47.52	2 15.27	11 35.95	10
18	7 16 42.4	8	*d*	+1 12.14	— 7 53.15	3 22.73	17 41.58	10
19	7 28 26.3	6	*d*	+2 23.23	—13 19.00	4 33.81	23 37.42	10
22	7 25 21.4	10	*e*	+2 11.36	—16 55.19	8 14.08	17 40 45.18	10
26	6 52 12.5	10	Lalande 33694	+2 12.23	—14 0.57	13 25.65	18 2 16.86	10
27	7 21 14.1	5	"	+3 35.60	—19 16.56	14 49.01	7 30.58	10
	7 25 41.7	4	Lalande 33966	—2 59.25	+ 2 10.91	14 49.38	7 41.21	10
28	7 9 36.6	12	"	—1 37.21	— 2 41.36	16 11.41	12 36.54	10
29	7 5 49.0	20	"	—0 12.96	— 7 39.73	17 35.65	17 31.91	10
30	6 56 59.1	20	"	+1 12.32	—12 27.35	18 19 0.91	—18 22 19.65	10

(1) This comparison is from distance and angle of position.

(2) 32986 Lalande is determined from 1209 Madras.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑱ — *		⑱'s apparent		A.
				Δα	Δδ	α	δ	
1852.	h. m. s			m. s.	′ ″	h. m. s.	° ′ ″	
(1) Oct. 1	7 1 53.3	10	B. A. C. 6293	—2 16.48	— 5 35.35	18 20 28.81	—18 27 5.96	10
		10	" 6294	—2 19.18	+ 2 48.10	20 27.95	27 3.75	10
2	6 45 28.6	10	" 6293	—0 19.40	—10 11.12	21 55.87	31 41.61	9
		10	" 6294	—0 51.87	— 1 49.02	18 21 55.25	—18 31 40.98	9

(1) There is $0^{s}.7$ difference between the relative position of 6293 and 6294 in the Catalogue, and their absolute positions now. The determination by 6293 is to be preferred as corroborated by the Madras observation. (The planet will probably be observed here till 15th December.)

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.	No. of Comp.
		h. m s.	° ′ ″		
B. A. C. 6019	6	17 44 43.60	—10 51 33.75	Mean of B. A. C. and Weisse XVII. 900.	
Weisse XVII. 810	9	40 43.89	11 17 8.52	Weisse's Catalogue.	
" 834	8	41 59.80	12 6 42.66	" "	
a	9.11	41 11.59	11 50 46.73	Equatorial from preceding star.	5
Weisse XVII. 835	9	42 3.86	12 53 13.12	Weisse's Catalogue.	
" 787	8	39 36.14	13 32 47.10	" "	
" 846	9	42 40.62	13 51 49.61	" "	
" 856	8.9	43 4.13	13 55 16.57	" "	
" 867	9	43 29.64	14 58 45.17	" "	
" 966	9	47 44.33	15 9 9.89	" "	
a′	9	47 47.12	15 17 42.17	Equatorial from preceding star.	10
B. A. C. 6065	6	47 41.44	15 46 54.32	Mean of B. A. C. 6065 and Rümker 6154.	
Madras 1209	8	48 11.21	15 39 21.84	Madras Catalogue.	
b	9.10	51 28.81	15 38 36.64	Equatorial from B. A. C. 6065.	10
Lalande 32986	8.5	53 31.02	16 13 7.76	" " "	10
" 33178	9	58 32.54	16 39 58.46	Lalande's Catalogue.	
" 33089	8.9	17 55 55.36	17 1 50.86	" "	
d		18 2 2.21	17 9 51.12	Equatorial from preceding star.	6
e		5 54.39	17 23 53.60	Equatorial from *d*.	4
Lalande 33694	7.8	11 5.19	17 48 20.51	Lalande's Catalogue.	
" 33966	8	17 40.27	18 9 57.60	" "	
B. A. C. 6293	6.7	22 36.95	18 21 36.92	Mean of B. A. C. 6293 and Madras 2317.	
" 6294	6	18 22 38.79	—18 29 58.02	Mean of B. A. C. 6294 and A. S. C. 2132.	

The position of the National Observatory at Washington by the latest determination is as follows: —

Latitude, +38° 53′ 39″.25

Longitude, + $5^{h.}$ $8^{m.}$ $10^{s.}.17$ from Greenwich.

Vide Washington Observations, Vol. I. Appendix, page 116.

LETTER FROM PROFESSOR CURLEY TO THE EDITOR.

Georgetown, D. C., 1852, *October* 25.

In the note on page 201 of the "Annals of the Observatory of Georgetown College," I say that Lieutenant Maury was the first person who made general use of the collimating eyepiece for determining nadir-points, &c. It seems from the information contained in the inclosed letter, which Lieutenant Maury and Professor Coffin were so kind as to send me, that my assertion was not correct. Any correction necessary on my part will be effected, if you will be so good as to insert at your leisure in your Journal the substance of the information contained in the letter.

JAMES CURLEY.

The inclosed letter from Professor Coffin contained a sketch of the history of this method of determining the nadir-point from the time of its suggestion by Bohnenberger in 1825 [*Astr. Nachr.*, IV. 327]. See also Gauss, *Best. d. Breitenunterschiedes Göttingen u. Altona*, p. 71, note.

G.

FROM A LETTER OF DR. PETERSEN TO THE EDITOR.

Altona, 1852, *October* 5.

In a letter from Professor **Secchi** subsequent to the one last sent you, he communicates the following observations of the two portions of Biela's Comet.

Preceding Comet.

1852.	M. T. Rome.	☄ α	☄ δ
	h. m. s.	m. s.	′ ″
Sept. 19	16 3 54.1	* −1 31.9	* +10 2.3
20	16 11 10.1	* −0 25.0	* +11 2.7

Following Comet.

1852.	M. T. Rome.	☄ α	☄ δ
	h. m. s.	m. s.	′ ″
Sept. 19	16 12 29.2	* +0 17.42	* −4 8.2
20	16 24 41.4	* +1 27.5	* −2 59.4

The comparison-star on September 19 was *Hist. Cél.* 19134, and its mean place for 1800.0 is

* α	* δ
h. m. s.	° ′ ″
9 34 37.80	+9 47 43.5

That used on the 20th is of the 7 magnitude, and occurs on **Harding**'s Charts,

$\alpha = 9^{h.}\ 38^{m.}\ ;\quad \delta = +9°\ 26'.$

Professor **Secchi** wrote in great haste, and had not time to reduce the observations of September 20.* . . . . .

Professor **Gasparis** in Naples writes me, in a letter dated September 21, that he discovered a new planet of the 9 magnitude on the 19th. It is the same one which **Chacornac** found on the 20th. Mr. **Gasparis** gives the two following positions: —

1852.	M. T. Naples.	⑳ α	⑳ δ
	h. m. s.	h. m. s.	° ′ ″
Sept. 19	10 20 21	0 12 10.73	+1 53 0.6
20	7 50 22	0 11 22.62	+1 47 16.8

Mr. **Rümker** has observed this asteroid at the Hamburg Observatory.

1852.	M. T Hamburg.	⑳ α	⑳ δ
	h. m s.	° ′ ″	° ′ ″
Sept. 30	11 9 32.5	0 29 11.5	+0 42 57.0
Oct. 2	8 5 6.4	0 1 42.7	+0 31 45.2

The assumed places of the comparison-stars were, —

	* α	* δ
	h. m. s.	° ′ ″
Sept. 30	0 6 15.58	+0 33 56.8
	0 7 4.36	0 28 42.3
	0 10 14.04	0 52 11.8
Oct. 2	0 1 55.25	+0 25 27.0

With our circle **Sonntag** found,

1852.	M. T. Altona.	⑳ α	⑳ δ
	h. m. s.	h. m. s.	° ′ ″
Oct. 3	11 8 20	23 59 24.10	+0 25 4.2

Of the new planet of Mr. **Hind**, I have received the following observations from Göttingen.

1852.	M. T. Göttingen.	⑲ α	⑲ δ
	h. m. s.	h. m. s.	° ′ ″
Aug. 28	11 47 57.94	22 17 13.38	−8 5 24.3
29	43 9.17	16 20.38	——
Sept. 1	28 45.30	13 43.6 ::	8 27 22.5
3	19 9.38	11 59.43	39 3.9
4	14 22.59	11 8.10	8 44 45.7
7	11 0 6.81	8 39.93	9 0 57.7
9	10 50 40.36	7 5.03	——
10	45 58.78	6 19.24	9 16 49.8
12	36 38.81	4 50.85	27 6.3
17	10 13 40.61	22 1 31.63	9 50 39.6
26	9 33 58.41	21 57 11.90	10 25 22.4
27	9 29 22.45	21 56 51.76	−10 28 13.7

The right-ascensions were determined by Dr. **Westphal** with the transit-instrument; the declinations by Mr. **Klinkerfues** with the meridian-circle.

A. C. PETERSEN.

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* I have made the necessary reductions in the rough observations, and have substituted the results in place of the numbers in the letter. — G.

FROM A LETTER OF PROFESSOR HUBBARD TO THE EDITOR.

Washington, 1852, *November* 4.

I have been examining some of the calculations made respecting Biela's Comet, in order to ascertain if possible the cause of the large deviation of theory from the observed places. I computed independently the perturbations during the time of visibility in 1845–46, and obtained the same values for the variations of elements that **Plantamour** found, (¹) but on transforming these into variations of the geocentric place of the comet found an enormous difference. The results given by **Plantamour** for two dates are: —

	δ l	δ b
1845, Dec. 19	+ 6.″38	— 1.′41
1846, April 6	—62.74	—13.51

No calculation is necessary to show that the last results are too great. I have obtained by differential formulas, and using two different methods,

	δ l	δ b
1845, Dec. 19	+0.″19	—1.″60
1846, April 6	+1.69	—1.83

and have still further confirmed this result by an independent

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(¹) *Astr. Nachr.*, XXV. pp. 123–126.

computation of the absolute places of the comet. **Plantamour**'s final elements depend on his assumed values of δl and δb, and are consequently yet liable to corrections which may nearly, if not entirely, fill the space now existing between theory and observation.

How this error originated it is of course impossible to say, but I have found that, in working by differential formulas, an error of unity in the index of the log. of δm or its coefficient will give for the dates in question,

	δl	δb
1845, Dec. 19	+ 5″.95	— 1″.45
1846, April 6	—59.62	—11.96

J. S. HUBBARD.

ASTEROID AND COMET OBSERVATIONS MADE AT THE HAMBURG OBSERVATORY,

By PROFESSOR CHARLES RÜMKER.
DIRECTOR OF THE OBSERVATORY.

MELPOMENE.

1852.	Hamburg M. T	⑱ α	Parall.	⑱ δ	Parall.	No. of Obs.	Apparent Places of Comparison-Stars.	
	h. m s.	° ′ ″	″	° ′ ″	″		h. m. s.	° ′ ″
Aug. 16	9 9 21 0	265 8 36.1	+1.1	—13 26 52.0	+5.3	8	R.A. 17 38 1.344	Dec. —13 14 33.8
17	8 56 15.4	265 11 20.5	0.9	13 34 12.5	5.3	14	17 39 44.653	13 32 47.0
Sept. 3	8 27 0.6	267 12 43.4	1.3	15 38 45.7	4.9	7	17 48 19.635	15 39 20.4
4	8 23 35.8	267 23 58.9	1.3	15 45 37.7	4.9	7	17 47 49.873	15 46 54.5
5	8 15 9.7	267 35 43.6	1.2	15 52 39.1	4.9	3	" "	" "
6	8 25 9 4	267 48 1.1	1.3	15 59 35.6	4.8	9	17 51 43.018	16 3 4.5
7	8 4 0.3	268 0 30.6	1.2	16 6 14.3	4.8	5	" "	" "
8	8 16 36.9	268 13 46.2	1.3	16 3 6.9	4.8	8	" "	" "
9	8 29 40.5	268 27 22.7	1.5	16 19 41.5	4.7	8	17 53 39.937	16 13 1.0
14	8 5 21.0	269 36 40.6	+1.4	—16 53 8.5	+4.7	7	17 59 14.905	—17 10 5.6

EUNOMIA.

1852.	Hamburg M. T.	⑮ α	Log. Fact. Parall.	⑮ δ	Log. Fact. Parall.	No. of Comp.	Apparent Places of Comparison-Stars.	
	h. m. s.	° ′ ″	″	° ′ ″	″		h. m. s.	° ′ ″
Oct. 9	9 50 18.7	79 51 29.7	9.8722 *n*	36 54 40.9	9.8225	6	R.A. 5 20 9.98	Dec. +37 12 21.2
12	9 25 55.1	80 17 54.8	9.8703 *n*	37 12 26.3	9.8362	6	5 22 24.15	37 12 50.2
16	9 5 11.8	80 41 18.5	9.8695 *n*	37 11 36.1	9.8418	8	{ 5 20 10.20 { 5 22 24.28	37 12 21.6 +37 12 50.5

FORTUNA.

1852.	Hamburg M. T.	⑲ α	Log. Fact. of Parall.	⑲ δ	Log. Fact. of Parall.	Remarks.
	h. m s.	° ′ ″	″	° ′ ″	″	
Sept. 2	9 22 31.1	333 13 51.7	9.4851 *n*	—8 32 54.8	9.9396	13 Comparisons.
2	11 23 56.3	333 12 37.2		8 33 23.7	9.9464	Meridian-Circle.
3	9 27 42.8	333 0 47.2	9.4515 *n*	8 38 34.4	9.9109	18 Comparisons.
3	11 19 9.0	332 59 45.8		8 38 59.0	9.9167	Meridian-Circle.
5	8 58 3.0	332 35 39.2	9.5179 *n*	8 49 10.3	9.9395	11 Comparisons.
5	11 9 36.6	332 31 32.4		8 50 6.5	9.9475	Meridian-Circle.
6	9 36 5.7	332 22 53.8	9.3585 *n*	8 55 10.9	9.9437	6 Comparisons.
6	11 4 41.2	332 22 6.9		8 55 30.6	9.9179	Meridian-Circle.
7	8 38 50 3	332 11 4.0	9.5114 *n*	9 0 23.3	9.9389	7 Comparisons.
7	11 0 6.6	332 9 55.5		9 1 0.9	9.9182	Meridian-Circle.
8	9 2 55.8	331 58 53.9	9.4558 *n*	9 6 1.9	9.9123	10 Comparisons.
8	10 55 23.1	331 57 59.0		9 6 21.9	9.9185	Meridian-Circle.
9	9 0 21.0	331 47 16.3	9.4494 *n*	9 11 1.7	9.9427	6 Comparisons.
9	10 50 40.3	331 16 14.9		9 11 35.8	9.9189	Meridian-Circle.
11	9 2 16.7	331 24 12.8	9.4135 *n*	9 21 37.0	9.9413	5 Comparisons.
11	10 41 18.6	331 23 10.5		9 21 58.5	9.9496	Meridian-Circle.
13	10 19 16.2	331 2 7.1	8.5272 *n*	—9 31 47.8	9.9195	2 Comparisons.

1852.	Hamburg M. T.	⑲ α	Log Fact. of Parall.	⑲ δ	Log. Fact. of Parall.	Remarks.
	h. m. s.	° ′ ″	″	° ′ ″	″	
Sept. 13	10 31 59.7	331 1 52.5		—9 31 58.3	9.9502	Meridian-Circle.
14	8 42 25.1	330 51 54.9	9.4285 *n*	9 36 10.0	9.9448	1 Comparison.
14	10 27 22.9	330 51 39.0		9 36 50.3	9.9505	Meridian-Circle.
16	8 29 34.4	330 32 51.5	9.4427 *n*	9 45 50.5	9.9450	3 Comparisons.
16	10 18 12.9	330 32 1.9		9 46 13.6	9.9511	Meridian-Circle.
17	8 51 50.3	330 23 32.9	9.4786 *n*	9 50 31.8	9.9442	4 Comparisons.
17	10 13 40.3	330 22 49.6		9 50 48.6	9.9514	Meridian-Circle.
21	9 55 44.6	329 49 42.4		10 7 35.1	9.9525	Meridian-Circle.
22	11 49 20.3	329 41 57.2	9.4800	10 11 43.1	9.9452	4 Comparisons.
25	9 38 15.2			10 21 50.4	9.9534	Meridian-Circle.
Oct. 2	9 8 50.3	328 54 43.7		10 41 24.5	9.9545	Meridian-Circle.
3	11 5 13.8	328 52 24.1	9.4848	10 43 46.5	9.9468	5 Comparisons.
8	8 44 51.1	328 48 46.5		10 51 24.9	9.9551	Meridian-Circle.
9	8 40 50.2	328 49 30.9		10 52 29.8	9.9552	" "
12	8 29 30.4	328 54 29.5		10 54 48.0	9.9554	" "
16	8 14 41.6	329 8 15.4		—10 54 55.9	9.9557	" "

Mean Places for 1852.0, *of Comparison-Stars, from Observations with the Meridian-Circle.*

α	No. of Obs.	δ	No. of Obs.	α	No. of Obs.	δ	No. of Obs.
h. m. s.		° ′ ″		h. m. s.		° ′ ″	
21 51 6.128	3	—10 52 59.4	3	22 7 9.531	3	—9 42 25.0	3
21 53 57.137	2	10 35 8.2	2	22 7 45.191	1	9 7 51.1	1
21 59 53.533	1	10 47 53.9	1	22 9 3.478	2	9 46 32.1	2
22 2 30.557	2	10 6 49.1	2	22 11 20.992	1	8 32 13.1	1
22 3 16.993	1	8 43 —		22 13 2.461	1	9 30 24.2	1
22 3 24.081	1	8 43		22 14 28.750	1	—8 13 40.2	1
22 4 46.715	2	—8 44 28.2	2				

TWENTIETH ASTEROID.

1852.	Hamburg M. T.	⑳ α	Log. Fact. of Parall.	⑳ δ	Log. Fact. of Parall.	No. of Obs.	Apparent Places of Compared Stars.	
							α	δ
	h. m. s.	° ′ ″	″	° ′ ″	″		h. m. s.	° ′ ″
Sept. 30	14 9 32.0	0 29 41.5	9.5992	+0 42 57.0	9.9015	6	0 10 14.04 0 7 4.36 0 6 15.58	+0 52 11.8 0 28 42.3 0 33 56.8
Oct. 2	8 5 24.4	0 6 3.3	9.6894 *n*	0 32 5.9	9.9028	7	0 0 6.85 0 1 55.25	0 31 45.2 0 25 27.1
3	10 12 2.0	359 51 39.7	9.1631 *n*	0 25 19.5	9.9021	3	0 1 55.27	0 25 27.1
6	8 38 0.0	359 13 25.4	9.5246 *n*	+0 13 10.6	9.9033	1	23 52 28.12 23 53 1.91	0 16 10.6 +0 14 46.7
8	8 27 49.3	358 48 16.5	9.5265 *n*	—0 3 59.1	9.9046	9	0 1 19.89	—0 7 36.1
9	8 0 32.8	358 36 11.8	9.5832 *n*	0 9 42.3	9.9051	7	0 1 19.90	0 7 36.2
12	8 6 25.8	358 0 42.6	9.5224 *n*	0 26 12.9	9.9063	8	23 53 6.62 23 53 55.86 23 54 26.82	0 35 49.0 0 31 3.0 0 41 17.6
13	7 52 29.2	357 49 34.2	9.5551	0 31 29.6	9.9066	7	23 53 6.62 23 53 55.86	0 35 49.1 0 31 3.1
16	7 43 58.6	357 17 40.3	9.5136 *n*	—0 46 37.9	9.9079	10	23 47 14.51	—0 42 34.3

SECOND COMET OF 1852.

1852.	Hamburg M. T.	☄ α	Log. Fact. of Parall.	☄ δ	Log. Fact. of Parall.	No. of Obs.	Apparent Places of Compared Stars.	
							α	δ
	h. m. s.	° ′ ″	″	° ′ ″	″		h. m. s	° ′ ″
Sept. 2	10 20 25.5	29 17 8.2	9.8968 *n*	43 59 50.8	9.6527	6	1 57 56.715	+44 3 16.9
3	10 33 39.7	29 35 31.2	9.8981 *n*	45 35 26.5	9.6040	6	2 1 51.830 2 2 3.840	45 30 43.7 45 31 56.4
5	10 21 50.0	30 12 1.5	9.9287 *n*	48 45 21.0	9.5713	12	2 2 16.668 2 2 22.490 2 3 31.648	48 45 7.9 48 53 52.7 +48 41 7.4

1852.	Hamburg M. T.	☄ α	Log. Fact. of Parall.	☄ δ	Log. Fact. of Parall.	No. of Obs.	Apparent Place of Compared Star α	Apparent Place of Compared Star δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
Sept. 6	10 27 14.8	30 30 47.6	9.9360 *n*	50 21 54.3	9.5239	6	2 1 1.282	+50 21 8.9
							2 3 49.764	50 22 31.2
7	10 16 53.6	30 49 58.0	9.9578 *n*	51 57 30.3	9.5182	8	2 5 39.457	51 49 4.0
							2 6 30.656	51 52 3.6
							2 6 46.133	52 1 49.1
8	10 18 16.8	31 9 34.1	9.9709 *n*	53 34 5.2	9.4772	11	2 3 16.263	53 51 15.5
9	9 45 39.1	31 29 10.0	0.0059 *n*	55 8 35.8	9.5315	4	2 10 29.669	55 13 27.5
							2 10 39.022	55 8 27.8
							2 12 7.331	55 9 51.7
14	11 20 28.7	33 22 38.3	0.0008 *n*	63 11 26.6	8.0575	3	2 7 46.464	63 15 35.7
							2 9 25.144	63 11 19.1
							2 11 59.427	62 55 15.2
							2 13 5.070	62 51 29.1
16	10 33 21.8	34 14 42.5	0.1075 *n*	66 13 25.1	8.6972	6	2 11 8.955	66 9 45.0
							2 14 39.437	65 52 24.5
17	10 3 17.0	34 42 15.8	0.1606 *n*	67 42 12.6	8.9449	5	2 23 14.253	67 42 48.5
22	8 37 3.9	37 46 57.0	0.3571 *n*	74 48 43.1	9.2180	6	2 31 17.81	74 46 28.1
23	8 47 2.9	38 38 27.0	0.3955 *n*	76 10 45.4	9.1194	1	2 42 0.40	76 28 25.5
25	9 26 46.4	40 46 28.5	0.4723 *n*	78 50 6.0	7.5028 *n*	5	2 46 47.53	78 49 30.4
Oct. 3	12 37 45.5	82 54 28.0	1.1003 *n*	87 37 40.6	9.4140 *n*	1	6 29 49.48	87 14 56.2
16	11 52 48.7	203 36 21.5	7.3512	80 11 46.1	9.8601	4	13 36 34.03	+80 6 10.2

TWENTIETH ASTEROID.

I am indebted to Dr. Petersen for the following series of observations of the twentieth asteroid by Professor Gasparis at Naples.

1852.	M. T. Naples.	⑳ α	⑳ δ
	h. m. s.	h. m. s.	° ′ ″
Sept. 21	8 55 51	0 10 25.72	+1 40 47.1
22	14 17 40	9 18.38	1 33 10.2
23	16 7 30	8 19.08	1 26 18.6
24	11 52 21	7 34.78	1 20 52.0
25	12 20 41	6 37.72	1 14 59.0
27	9 16 40	4 55.34	1 3 20.6
28	9 44 47	3 59.84	0 56 35.2
29	8 29 0	3 7.00	0 50 47.0
30	8 55 22	2 11.62	0 44 15.7
Oct. 1	11 31 58	0 1 11.20	+0 37 18.6

The stars used for comparison were Weisse O., 44, 45; XXIII. 850, 884, 1143, 1179, 1186.

G.

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The Semidiameters of Venus and Mars investigated from the Observations made with the Mural-Circle of the Naval Observatory at Washington, during the Years 1845 and 1846, by Professor Benjamin Peirce.
Observations of Melpomene, made with the Filar-Micrometer of the Washington Equatorial, by Mr. James Ferguson.
Letter from Professor Curley to the Editor.
From a Letter of Dr. Petersen to the Editor.
From a Letter of Professor Hubbard to the Editor.
Asteroid and Comet Observations made at the Hamburg Observatory, by Professor Charles Rümker.
Twentieth Asteroid.

Cambridge: Metcalf and Company, Printers to the University.

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LATITUDES AND LONGITUDES OF THE PRINCIPAL OBSERVATORIES.

COMPILED BY B. A. GOULD, Jr.

Having been requested by Lieutenant Davis to arrange for the Astronomical Ephemeris (shortly to appear) a Table of Latitudes and Longitudes of the principal Observatories, I have devoted some time and attention to the critical preparation of this catalogue. But since the values decided upon differ considerably in many cases from those in the other published catalogues, and in some few instances from the values which appear to be made use of at the Observatories themselves, I feel some hesitation in publishing them without asking the attention of astronomers to the catalogue, that such inaccuracies as it may contain may be corrected as speedily as possible. The sources of information are given in each case, and when possible the probable error also is given with the determination. One important change consists in the adoption of the differences of longitude between Altona and Pulkowa, and Greenwich and Altona, as determined by Struve in his chronometric expeditions of 1843 and 1844. The adoption of these values necessarily implies a corresponding change for the longitude of those Observatories whose position has been fixed by their difference of longitude from Altona or Pulkowa, or from other Observatories dependent upon these. The differences of longitude of the American Observatories are deduced from the telegraphic determinations of the United States Coast-Survey, — and have been communicated by Professor Bache, by authority of the Honorable Secretary of the Treasury. I have endeavored to include in the list all Observatories now in a state of astronomical activity, or which have been so within the last quarter of a century. Any corrections or additions with which astronomers may favor me will be gratefully acknowledged.

Åbo. . . N. Lat. 60° 26′ 56″.8 ± 0″.11. Argelander, *Obs. Astron.*, I. p. xxi.
Long. E. from Paris, $1^{h.}$ $19^{m.}$ $47^{s.}.3$. *Astr. Nachr.*, IX. 264.

This Observatory was abandoned, and the instruments transferred, together with the University of Finland, to Helsingfors, in consequence of the great fire of 1827, by which the University buildings, library, &c. were destroyed.

Altona. . N. Lat. 53° 32′ 45″.27. Gauss, *Bestimmung des Breiten-Unterschiedes zwischen den Sternwarten von Göttingen und Altona*, p. 71. In the edition of Schumacher's *Hülfstafeln*, published by Warnstorff, Altona, 1845, the latitude of Altona is given p. 114, as +53° 32′ 45″.7.
Long. E. from Greenwich, $0^{h.}$ $39^{m.}$ $46^{s.}.151$ ± $0^{s.}.042$. Struve, *Expédition Chronometrique executée in* 1844, *entre Altona et Greenwich*, p. 206.

Athens. . N. Lat. 37° 58′ 20″ ± 1″. Bouris, *Astr. Nachr.*, XXXIII. 197.
Long. E. from Paris, $1^{h.}$ $25^{m.}$ $34^{s.}.23$ ± $1^{s.}$. *Ergänzungs-Heft zu den Astr. Nachr.*, 1849, p. 151. This longitude was obtained from moon-culminating stars observed on ten nights at Athens and Hamburg. The result of a series observed at Athens and Copenhagen gave the longitude of Athens $6^{s}.84$ farther East, but this series was rejected. *Ibid.*, pp. 150, 151, 158. Diminishing the E. longitude of Hamburg in conformity with Struve's chronometric determination, we have for the longitude of the meridian-circle $1^{h.}$ $25^{m.}$ $33^{s.}.73$ ± $1^{s.}$.

The center of the Observatory is $0^{s.}.19$ W. from the meridian-circle, *Erg.-Heft z. d. Astr. Nachr.*, p. 152.

Berlin. . N. Lat. 52° 30′ 16″.68 ± 0″.2. Encke, *Astr. Nachr.*, XXIII. 372.
For the Longitude of the center of the Observatory, we have

	h.	m.	s	
Berlin E. from Altona (*Berl. Astr. Jahrb.*, 1839, p. 275),	0	13	48.78	± 0.03
Altona E. from Greenwich,	0	39	46.15	
Berlin " "	0	53	34.93	

The old Observatory was situated 0′ 56″.72 North (*Berl. Astr. Jahrb.*, 1839, p. 242; *Astr. Nachr.*, XXIII. 370), and 0^{s}.39 West (*Ibid.*, pp. 261, 265), of the new one. Hence we have for the old Berlin Observatory,

N. Lat., 52° 31′ 13″.4.
Long. E. from Greenwich, 0$^{h.}$ 53$^{m.}$ 34$^{s.}$.54.

Bilk. N. Lat. 51° 12′ 25″. *Astr. Nachr.*, XXVII. 300.
Long. W. from Berlin, 0$^{h.}$ 26$^{m.}$ 30$^{s.}$.0. *Ibid.*

Bonn. N. Lat. 50° 43′ 45″.0.
Long. E. from Paris, 0$^{h.}$ 19$^{m.}$ 3$^{s.}$.0. } Orally communicated by Professor Argelander to the compiler.

The provisional Observatory on the "Alter Zoll," in which were made the observations published in Vol. I. of the Bonn series, was situated in

N. Lat. 50° 44′ 9″.
Long. E. from Paris, 0$^{h.}$ 19$^{m.}$ 5$^{s.}$.5. *Bonn Astr. Beobb.*, I. p. i.

Breslau. N. Lat. 51° 6′ 56″.0. (MS. communication from Professor Boguslawski to Professor Encke.) *Berl. Astr. Jahrb.*, 1852, p. 289. The value given in the *Berl. Jahrb.* previously to 1851, was 51° 6′ 30″.0.

The Longitude given in the table is derived from a mean of four determinations of the longitude E. from Paris, viz.:—

	h.	m.	s.
Triangulation in 1805 (fire-signals), *Astr. Nachr.*, XVI. 371,	0	58	48.6
Steczkowski (6 star-immersions), *Ibid.*,			48.17
Hansen (occultations), *Astr. Nachr.*, XVII. 170,			48.74
Erman and Petersen (meteors), *Ast. Nachr.*, XIX. 27,			48.67
Mean, Breslau E. from Paris,	0	58	48.54

Brussels. N. Lat. 50° 51′ 10″.7. *Annales de l'Obs. de Bruxelles*, 1837, p. 264.
Long. W. from Greenwich, 0$^{h.}$ 17$^{m.}$ 27$^{s.}$.6. Quetelet, *Mém. de l'Acad. R. de Bruxelles*, XVI. 18.

Cambridge (Mass.). N. Lat. 42° 22′ 48″.60. Peirce, *Mem. Amer. Acad.*, *N. S.*, II. 203.
Long. by the telegraphic determinations of the U. S. Coast-Survey,
Cambridge E. from Stuyvesant Garden, N. Y.,

	h	m.	s.
By 34 sets of clock-signals,	0	11	26.10
" 10 " " star-signals (Western),			26.13
" 24 " " " (exchanged E. and W.),			25.96
" 17 " " " (Eastern),			26.18
Mean,	0	11	26.09
Geodetic reduction to dome of Cambridge Observatory,			—0.02
Stuyvesant Garden E. of Jersey City (geodetic),		0	11.93
Cambridge E. from C. S. Station, Jersey City,	0	11	38.00
Jersey City E. from Washington (see Philadelphia),	0	12	3.54
Cambridge (dome) E. from Washington,	0	23	41.54

Cambridge (Eng.). N. Lat. 52° 12′ 51″.76. *Camb. Phil. Trans.*, V. 279.
Long. E. from Greenwich, 0$^{h.}$ 0$^{m.}$ 23$^{s.}$54. *Ibid.*, III. 168.

Cape of Good Hope. S. Lat. 33° 56′ 3″. Henderson, *Mem. R. Astr. Soc.*, VI. 130.
Long. E. from Greenwich,

		h.	m.	s.		
By Greenwich Observations,		1	13	56.1	*Ibid.*,	p. 126.
" Cambridge	"			55.04	"	p. 127.
" Åbo	"			58.56	"	p. 128.
" Edinburgh	"			54.2	"	p. 129.
Mean,		1	13	56.0		

Christiania. N. Lat. 59° 54′ 43″.7.
Long. E. from Paris, 0$^{h.}$ 33^{m} 33$^{s.}$.3. } *Astron. Journ.*, II. 173.

Cincinnati. N. Lat. 39° 5′ 54″. *Astr. Nachr.*, XXIII. 313.
Long. W. from Washington, 0^{h} 29$^{m.}$ 46$^{s.}$.85. (U. S. Coast-Survey.) *Proc. Amer. Assoc. for Adv. Science*, Cincinnati, 1851, p. 118.

Copenhagen. By Copenhagen Observatory is usually understood the "Round Tower" of the University. The new instruments are, however, mounted in a temporary wooden building known as "Holkens Bastion." (See *Astr. Nachr.*, XIX. 119).

N. Lat. of the Round Tower, 55° 40′ 53″.0. *Astr. Nachr.*, V. 366.

For the Longitude,

	h. m. s.	
Holkens Bastion E. from Altona,		
Hansen (*Astr. Nachr.*, VIII. 281),	0 10 32.585	139.88
Schumacher (*Astr. Nachr.*, IX. 463),	32.565	19.42
Mean,	10 32.583	
Altona E. from Greenwich,	39 46.151	
Holkens Bastion E. from Greenwich,	50 18.734	
Round Tower E. from Holkens Bastion (Wurm, *Astr. Nachr.*, III. 438; V. 337),	0.57	
Round Tower E. from Greenwich,	0 50 19.30	

Cracow. N. Lat. 50° 3′ 50″.0 ± 0.09. Weisse, *Astr. Nachr.*, VIII. 175; XVI. 256.

Longitude E. from Paris,

	h. m. s.	
Mean of 18 obs. by Wurm (*Astr. Nachr.*, VIII. 459), (6 of the 25 being rejected),	1 10 28.986	± 0.461
" 25 " Steczkowski (*Astr. Nachr.*, XVI. 352),	30.221	± 0.301
" 4 " Steczkowski (*Astr. Nachr.*, XVIII. 332),	29.760	± 0.085
" 16 " of three occultations (Steczkowski, *Astr. Nachr.*, X. 232),	30.95	± 0.253

Assigning to each of these determinations a weight proportional to the number of observations from which it was derived, we obtain the mean,

Cracow E. from Paris,	1 10 29.78

Dorpat. N. Lat. 58° 22′ 47″.05. Struve, *Observ. Astron.*, VI. p. lx.

	h. m. s.	
Long. E. from Paris,	1 37 32.70.	Wurm, *Astr. Nachr.*, III. 437.
	33.5	Bessel, " III. 46.
Mean,	1 37 33.1	

Dublin. N. Lat. 53° 23′ 13″.

Long. W. from Greenwich, $0^{h.}\ 25^{m.}\ 22^{s.}$. *Astr. Nachr.*, X. 274.

Durham. N. Lat. 54° 46′ 6″.4.

Long. W. from Greenwich, $0^{h.}\ 6^{m.}\ 18^{s.}.0$. *Astr. Nachr.*, XXVI. 215.

Edinburgh. N. Lat. 55° 57′ 23″.2.

Long. W. from Greenwich, $0^{h.}\ 12^{m.}\ 43^{s.}.0$. *Edinb. Observ.*, X. p. v.

Florence. N. Lat. 43° 46′ 40″.8. Zach, *Corresp. Astron.*, I. 15.

Long. E. from Paris, $0^{h.}\ 35^{m.}\ 40^{s.}.2$. *Ibid.*, p. 14.

Geneva.

N. Lat. by observations of pole-star,	46° 11′ 58″.72 ± 0″.1	
" " " nadir-point,	58.97 ± 0.1	
Mean,	46 11 58.84	Plantamour, *Mém. de la Soc. de Physique et d'Hist. Nat. de Genève*, XI. 15.

Long. E. from Paris, $0^{h.}\ 15^{m.}\ 16^{s.}.22$. *Astr. Nachr.*, XX. 7.

Georgetown. N. Lat. 38° 54′ 26″.1. *Astron. Journ.*, I. 69.

Long. W. from Washington, $0^{h.}\ 0^{m.}\ 6^{s.}.20$. *Astr. Journ.*, I. 70.

Göttingen. Gauss found, *Best. d. Breit.-Untersch.*, p. 71, for the N. Latitude of the meridian-circle, 51° 31′ 47″.85, with the weight 60.9.

The Longitude of the same Gauss found (*Ibid.*) by his trigonometrical survey to be West of the meridian-circle in Altona by 7.211 Paris Toises. Using Bessel's data we find $1^{s.}$ = 148.33 Toises, whence we have,

	h. m. s.
Göttingen West of Altona,	0 0 0.049
Altona East of Greenwich,	0 39 46.151
Göttingen East of Greenwich,	0 39 46.102

For the old Observatory,
Lat. = +51° 31′ 55″.6. *Monatl. Corr.*, XXVII. 483.
Long. E. of Paris, $0^{h}\ 30^{m}\ 25^{s}.2$. *Astr. Nachr.*, II. 407, 108.

Gotha. . . . (Seeberg.)
N. Lat. 50° 56′ 5″.19. Gauss, *Best. d. Breit.-Untersch.*, p. 80.
For the Longitude E. from Paris,
Wurm found by 11 occultations (*Astr. Nachr.*, II. 405), h. m. s. 0 33 34.8 ± 0.13
Peters found (*Ast. Nachr.*, V. 68),

		Weight.
Seeberg East from Altona,	3 10.2	2
" " Göttingen,	3 8.9	15
West " Königsberg,	39 5.6	18
East " Paris,	33 31.3	24
West " Vienna,	22 38.0	17

Whence, using the present data, we find,
Seeberg E. from Paris, 0 33 33.66
Mean, 0 33 34.2
For the Observatory attached to Professor Hansen's house,
Long. E. from Paris, $0^{h}\ 33^{m}\ 30^{s}.016$. Schumacher, *Astr. Nachr.*, XXIII. 263.

Greenwich. . N. Lat. 51° 28′ 38″.2. Airy, *Mem. Astr. Soc.*, XVII. p. 49.
Long. W. from Paris, $0^{h}\ 9^{m}\ 21^{s}.46 \pm 15$. Henderson, *Phil. Trans.*, 1827, p. 286. See also Washington.

Hamburg. . N. Lat. 53° 33′ 7″, by geodetical connection with Altona. *Preface to* Rümker's *Catalogue*.
The Longitude given in the table is derived thus:

	h. m. s.
Hamburg E. from Altona (Hansen, *Astr. Nachr.*, VIII. 277),	0 0 7.41
Altona E. from Greenwich (Struve, *Exp. Chron. de* 1844),	0 39 46.15
Whence Hamburg E. from Greenwich,	0 39 53.56

Hudson. . . N. Lat. 41° 14′ 12″.6. Loomis, *Trans. Am. Phil. Soc.*, N. S., X. 61.
Long. W. from Philadelphia (U. S. Coast-Survey),

	h. m. s.
By 3 sets Eastern clock-signals,	0 25 5.72
" 2 " Western "	5.68
	0 25 5.70
Philadelphia E. from Washington,	7 33.64
Hudson W. from Washington,	0 17 32.06

Professor Loomis deduced from moon-culminations,
Hudson W. from Greenwich, $5^{h}\ 25^{m}\ 41^{s}.3$. *Astr. Journ.*, I. 67.

Kasan. . . N. Lat. 55° 47′ 23″.1. *Astr. Nachr.*, XXVIII. 47.
Long. E. from Berlin, $2^{h}\ 22^{m}\ 57^{s}.0$. *Berl. Astr. Jahrb.*, 1854, p. 293.

Konigsberg. . N. Lat. 54° 42′ 50″.4. Bessel, *Astr. Nachr.*, I. 248.
Long. E. from Paris, h. m. s. 1 12 38.8 Wurm, *Astr. Nachr.*, III. 437.
38.93 Bessel, " III. 46.
Mean, 1 12 38.9

Kremsmunster. N. Lat. 48° 3′ 24″.0. *Astr. Nachr.*, XI. 367.
Long. E. from Paris, $0^{h}\ 47^{m}\ 11^{s}.96$. Schumacher, *Astr. Nachr.*, XXIII. 263.

Leipsic. . . (Pleissenburg.)
N. Lat. D'Arrest, *Astr. Nachr.*, XXVIII. 148, 51° 20′ 20″.7 ± 0.36 Weight. 26.37
D'Arrest, *Astr. Nachr.*, XXVIII. 160, 20.4
Long. E. from Greenwich, $0^{h}\ 49^{m}\ 28^{s}.5$.

Leyden. . . N. Lat. 52° 9′ 28″.16 ± 0″.15 } Kaiser, *Astr. Nachr.*, XVII. 100.
Long. E. from Paris, $0^{h}\ 8^{m}\ 35^{s}.97 \pm 0^{s}.19$ }

Liverpool. . Lat. +53° 24′ 47″.8. } *Naut. Alm.*, 1852, p. 598.
Long. W. from Greenwich, $0^{h}\ 12^{m}\ 0^{s}.11$ }

London. . (Mr. Bishop's Observatory.)
N. Lat. 51° 31′ 29″.8. *Astr. Obs. at the Observatory South Villa*, p. xix.
Long. W. from Greenwich, $0^{h.}$ $0^{m.}$ $37^{s.}.1$.

Madras. . N. Lat. 13° 4′ 9″.2.
Long. E. from Greenwich, $5^{h.}$ $20^{m.}$ $57^{s.}$. TAYLOR, *Madras General Catal.*, 1844, *Pref.* p. ii.

Mannheim. N. Lat. 49° 29′ 12″.9. *Astr. Nachr.*, XII. 129.
Long. E. from Paris, as determined

	h m. s.
By WURM, from occultations (*Astr. Nachr.*, VIII. 458),	0 24 29.92
" connection with Strasburg (*Astr. Nachr.*, XV. 280),	29.87
" " " Vienna (*Astr. Nachr.*, XV. 279; XXIII. 263),	30.28
" " " Dunkirk (MÜFFLING, *Astr. Nachr.*, XV. 279),	30.05
" OLUFSEN from Solar Eclipse (*Astr. Nachr.*, XXII. 234),	30.10
Mean,	0 21 30.04

Markree. . N. Lat. 54° 10′ 31″.72. *Astr. Journ.*, II. 12.
Long. W. from Greenwich, $0^{h.}$ $33^{m.}$ $48^{s.}.4$. *Naut. Alm.*, 1852, p. 598.

Marseilles. N. Lat. 43° 17′ 49″. *Monatl. Corresp.*, XIII. 139.
Long. E. from Paris, according to

	No. Obs.	h. m. s.
LINDENAU (*Monatl. Corr.*, XIX. 421),	4	0 12 7.7
WURM (*Monatl. Corr.*, XXVI. 185),	19	7.6
" (*Astr. Nachr.*, IV. 33),	12	7.5
INNES (*Astr. Nachr.*, VIII. 435),	4	7.05
Mean,		0 12 7.53

Milan. . (Brera.)
N. Lat. 45° 28′ 0″.7. *Corresp. Astron.*, V. 300; *Effem. Astr. di Milano*, 1846, *App.*, pp. 73–86.
Long. E. from Paris,

	m. s.	h. m. s.
DAUSSY found from 31 occultations (*Conn. d. Temps*, 1836, *Add.*, p. 131),		0 27 21.91
LITTROW found Milan W. from Vienna (*Ibid.*),	28 45.63	
	56 11.07	
		0 27 25.44
Mean,		0 27 25.18

Modena. . N. Lat. 44° 38′ 52″.75. BIANCHI, *Astr. Nachr.*, XVI. 221; *Atti del R. Osserv. di Modena*, I. 336 (1834).
Long. E. from Milan, $0^{h.}$ $6^{m.}$ $55^{s}.99$. *Id.*, p. 337.
Hence E. from Paris,

	h. m. s.	
By comparison with Milan,	0 34 20.45	
WURM from occultations,	23.5	*Astr. Nachr.*, I. 504.
" " "	24.5	" " III. 222.
STECZKOWSKI from occultations,	21.81	" " XVI. 299, 302.
OLUFSEN from solar eclipse,	22.32	" " XXII. 234.
Mean,	0 34 22.51	

Moscow. . N. Lat. 55° 45′ 19″.8. SCHWEIZER, *Astr. Nachr.*, XXVII. 215.

	h. m. s.	
Long. Moscow E. from Pulkowa,	0 28 58.2	*Astr. Nachr.*, XXIV. 90.
Pulkowa E. from Greenwich,	2 1 19.09	
Moscow " " "	2 30 17.29	

Munich. . (Bogenhausen.)
N. Lat. 48° 8′ 45″. SOLDNER, *Astr. Nachr.*, IX. 422.
Long. E. from Paris, $0^{h.}$ $37^{m.}$ $4^{s.}.98$. *Astr. Nachr.*, VIII. 148.

Naples. . N. Lat. 40° 51′ 46″.63. BRIOSCHI, *Astr. Nachr.*, V. 294.
The Longitude adopted is that by which PETERS has apparently made his reductions, *Astr. Nachr.*, XXIII. 302, 303, according to which we have,

Naples E. from Berlin, $0^{h.}$ $3^{m.}$ $26^{s.}.0$.

For determinations from solar eclipses by BRIOSCHI and SANTINI, see *Astr. Nachr.*, VI. 413.

Oxford. . . N. Lat. 51° 45′ 36″.0 } *Naut. Alm.*, 1852, p. 599.
Long. W. from Greenwich, $0^{\rm h}\ 5^{\rm m}\ 2^{\rm s}.6$ }

Padua. . . N. Lat. 45° 24′ 2″.5. Santini, *Astr. Nachr.*, VI. 411; XVII. 346.
Long. E. from Paris,
Wurm (*Astr. Nachr.*, IV. 347), h. m. s. 0 38 7.7
Padua E. from Milan by powder signals (Fallon, *Astr. Nachr.*, IV. 115), h. m. s. 0 10 43.27
Milan E. from Paris, 27 24.18
0 38 7.45
Mean, Padua E. from Paris, 0 38 7.57

Palermo. . . N. Lat. 38° 6′ 44″. Cacciatore, *Del Real Osservatorio di Palermo Libri* VII., VIII., IX., p. 2; *Storia Celeste del R. Osserv. di Palermo*, in *Ann. d. Wiener Sternwarte*, XXIV. 6.
Long. E. from Paris, $0^{\rm h}\ 44^{\rm m}\ 4^{\rm s}.0$. Daussy, *Add. Conn. d. Temps*, 1835, p. 8.
Bianchi, *Astr. Nachr.*, XVII. 350, calls the latitude of the Palermo Observatory, +38° 6′ 25″.50.

Paramatta. . S. Lat. 33° 48′ 49″.79. Rümker, *Phil. Trans.*, 1829, Part III. p. 16.
Long. E. from Greenwich, $10^{\rm h}\ 4^{\rm m}\ 6^{\rm s}.25$. *Ibid.*, p. 29.

Paris. . . N. Lat. 48° 50′ 13″.2. *Conn. d. Temps*, 1835, p. 356.
Long. as above under Greenwich.

St. Petersburg. (Academy.)
N. Lat. 59° 56′ 29″.67.
Long. W. from Pulkowa, $0^{\rm m}\ 5^{\rm s}.194$. Struve, *Description de l'Obs. de Poulkova*, p. 292.

Philadelphia. N. Lat. 39° 57′ 7″.5. MS. communication from Professor Kendall.
Long. E. from Washington (U. S. Coast Survey),
By 5 sets Eastern clock-signals, m. s. 7 33.66
" " Western " 33.60
Mean, 7 33.63
Long. Jersey City Station E. from Washington,
By 2 sets Eastern clock-signals, 12 3.58
" " Western " 3.52
Mean, 12 3.56
Long. W. from Jersey City Station,
By 8 sets Eastern clock-signals, 4 29.91
" " " " " 29.84
Mean, 4 29.88

Hence we may use,
Jersey City Station E. from Philadelphia, h. m. s. 0 4 29.89
" " " Washington, 0 12 3.53
Philadelphia, " " 0 7 33.64

Prague. N. Lat. 50° 5′ 18″.5. David, *Astr. Nachr.*, VIII. 198.
Long. E. from Paris,
Mean of 6 occultations (*Astr. Nachr.*, XVI. 299, 302), h. m. s. 0 48 21.66 ± 4.15
Hansen from occultations (*Astr. Nachr.*, XVII. 170), 19.59 ± 3.67
Mean, Prague E. from Paris, 0 48 20.50

Pulkowa. N. Lat. 59° 46′ 18″.70. Struve, *Descr. de l'Obs. de Poulkova*, p. 290.
Long. E. from Altona (*Exp. Chron. de* 1843, p. 144), h. m. s. 1 21 32.523 ± 0.039
Altona E. from Greenwich (*Exp. Chron. de* 1844, p. 206), 0 39 46.151 ± 0.042
Pulkowa E. from Greenwich (*Exp. Chron. de* 1844, p. ix.), 2 1 18.674 ± 0.057

Rome. . . (Collegio Romano.)
N. Lat. 41° 53′ 54″. *Conn. d. Temps*, 1840, p. 354.
Long. E. from Greenwich, $0^{\rm h}\ 49^{\rm m}\ 54^{\rm s}.7$. *Astr. Nachr.*, VIII. 88.

San Fernando. N. Lat. 36° 27′ 45″. *Corresp. Astron.*, XIV. 240.
Long. W. from Paris, $0^{h.}$ $31^{m.}$ $10^{s.}.6 \pm 0^{s.}.31$. *Astr. Nachr.*, IX. 358.

Santiago. . (Observatory of the U. S. Astronomical Expedition.)
S. Lat. 32° 26′ 21″.8.
Long. W. from Greenwich, $4^{h.}$ $42^{m.}$ $18^{s}.9$. Gilliss, *Astron. Journ.*, II. 118.

Senftenberg. . N. Lat. 50° 5′ 10 .1.
Long. E. from Berlin, $0^{h.}$ $12^{m.}$ $15^{s.}$. } *Astr. Nachr.*, XXXI. 174, 331.

Vienna. . . N. Lat. 48° 12′ 35″.5. *Berl. Astr. Jahrb.*, 1852, p. 290.
Long. E. from Paris, $0^{h.}$ $56^{m.}$ $11^{s.}.07$. Schumacher, *Astr. Nachr.*, XXIII. 263.

Washington. . N. Lat. 38° 53′ 39″.25. *Astron. Journ.*, III. 12.
Long. W. from Greenwich, as derived from data of the U. S. Coast-Survey, up to 1852, $5^{h.}$ $8^{m.}$ $11^{s.}.2$.
Lieutenant Maury uses $5^{h.}$ $8^{m.}$ $10^{s.}.17$. *Astron. Journ.*, III. 12.
The situation of the first, or provisional, Naval Observatory, in which were made the observations published by Lieutenant Gilliss was,
N. Lat. 38° 53′ 32″.8. Gilliss, *Astr. Obs.*, p. viii.
Long. W. from Greenwich, $5^{h.}$ $8^{m.}$ $4^{s.}.6$. *Ibid.*, p. x.

Wilna. . . N. Lat. 54° 40′ 59″.1. *Astr. Nachr.*, IV. 562.
Long. E. from Paris,

	h. m. s.
Wurm from 22 occultations (*Astr. Nachr.*, VIII. 96),	1 31 50.4
Steczkowski from 1 occultation (*Astr. Nachr.*, XVI. 302),	48.3
Mean,	1 31 50.31

FROM A LETTER OF DR. PETERSEN TO THE EDITOR.

Altona, 1852, *November* 5.

With this I send a few observations which have not yet been printed, and the Elements of the highly interesting comet of Westphal, which Sonntag has computed at my suggestion, together with an ephemeris up to January 23. These Elements agree very closely with those of Marth, and being derived from a period of 91 days must be tolerably trustworthy. The comet will be observable, moreover, in the meridian until the end of January, — an extremely unusual case, that a comet should remain so long near the north pole.

ELEMENTS AND EPHEMERIS OF THE SECOND COMET OF 1852.

The Elements are computed from the following observations: —

1852.	M. T. Berlin. h. m. s.	☄ α ° ′ ″	☄ δ ° ′ ″	Place.
July 27	14 8 13.3	18 52 0.5	+ 3 3 57.5	Altona, Hamburg.
Sept. 10	9 56 11.1	31 49 21.0	+56 42 52.6	Berlin.
Oct. 26	11 46 8.7	208 32 20.8	+74 24 57.1	Altona, Hamburg.

$T = 1852$, Oct. 12.85269 M. T. Berlin.
$\pi - \Omega = 57° 6′ 11″.3$
$\Omega = 346\ 11\ 32.8$ Mean Equinox, August 0.
$i = 40\ 54\ 41.9$
Log $q = 0.0968420$
" $a = 1.1891656$
" $e = 0.9191398$
Period = 60.8 years.

Ephemeris for Mean Berlin Midnight.

1853.	☄ α h. m. s.	☄ δ ° ′	Log △
Jan. 1	12 51 26	+68 58.0	0.0331
Jan. 2	12 50 10	+69 4.9	
3	45 46	11.5	
4	41 12	17.6	0.0354
5	36 28	23.3	
6	31 35	28.5	
7	26 32	33.1	
8	21 22	37.0	0.0400
9	16 2	40.1	
10	10 35	42.5	
11	12 5 1	44.4	
12	11 59 20	+69 45.5	0.0453

1853.	α	δ	Log Δ	1853.	α	δ	Log Δ
	h. m. s.	° ′			h. m. s.	° ′	
Jan. 13	11 53 32	+69 45.6		Jan. 23	10 53 18	+68 49.4	
14	47 10	41.7		24	47 58	37.7	0.0667
15	41 45	42.8		25	42 12	24.9	
16	35 47	40.0	0.0514	26	36 32	68 11.1	
17	29 46	36.1		27	31 1	67 56.2	
18	23 44	31.3		28	25 37	40.4	0.0761
19	17 41	25.3		29	20 21	23.7	
20	11 40	18.1	0.0585	30	15 13	67 6.0	
21	11 5 39	9.7		31	10 14	66 47.2	
22	10 59 42	+69 0.1		Feb. 1	10 5 21	+66 27.6	0.0865

OBSERVATIONS OF THE TWENTIETH ASTEROID, AT THE VIENNA OBSERVATORY.

1852.	M. T. Vienna.	⑳ α	Log. Fact. Parall.	⑳ δ	Log. Fact. Parall.	No. Comp.	*
	h. m. s.	h. m. s.		° ′ ″			
Oct. 14	8 22 51.5	23 50 34.49	8.325	—0 36 37.9	9.876	6	Piazzi XXIII. 227.
17	8 28 30.3	23 48 30.29	8.249	0 51 18.7	9.878	6	*Anon.* 9 Magnitude.
21	8 13 58.7	23 46 5.73	8.233	1 8 48.8	9.880	6	
22	7 50 18.4	23 45 33.05	8.312	—1 12 40.7	9.879	6	

Mean Places for 1852.0 *of Comparison-Stars.*

*	α	δ	Authority.
	h. m. s.		
Piazzi XXIII. 227	23 47 12.32		Mean of Piazzi XXIII. 227, Taylor 10932, Rümker 11738.
Anon. 9	23 47 16.51	—1 6 12.4	Mean of 4 comparisons with the preceding stars, and 2 observations with the meridian-circle.

TWENTY-FIRST ASTEROID.

A NEW planet, resembling a star of 9.10 magnitude, was discovered by Mr. GOLDSCHMIDT at Paris, November 15. He obtained the following comparison with LALANDE 5251, of which the mean place for 1800.0 is

$$\alpha = 2^{h.}\ 39^{m.}\ 31^{s.}.12 \qquad \delta = +12°\ 36'\ 45''.1$$

	M. T. Paris.	α	δ
	h. m. s.	m. s.	′ ″
Nov. 18	11 29 20	* —1 14.96	* —8 31.0
	Daily Motion	—58.19	—1 17

TWENTY-SECOND ASTEROID.

MR. HIND discovered a new planet at Mr. BISHOP'S Observatory, November 16. He estimates it as of the 10.9 magnitude. By comparison with LALANDE 10056, he obtained,

	Greenwich M. T.	α	N. P. D.
Nov. 17	$11^{h.}\ 51^{m.}\ 52^{s.}$	$5^{h.}\ 12^{m.}\ 49^{s.}.38$	65° 26′ 44″.5

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ASTRONOMICAL OBSERVATIONS MADE AT THE HAMBURG OBSERVATORY,

By PROFESSOR C. RÜMKER,
DIRECTOR OF THE OBSERVATORY.

[Communicated by Lieutenant MAURY.]

SECOND COMET OF 1852.

1852.	Hamburg M. T.	☄ App. α	Log. Factor of Parallax.	☄ App. δ	Log. Factor of Parallax.	Comp.	Comparison-Stars.
	h. m. s.	° ′ ″		° ′ ″			
Nov. 4	9 31 47.5	210 23 29	9.8519	+70 46 31.0	9.8924	2	*a . b . c*
6	9 46 12.3	210 38 37	9.7293	+70 7 15.7	9.9059	3	*d . e . f*

Apparent Places of Comparison-Stars.

*	App. α	App. δ	*	App. α	App. δ
	h m. s.	° ′ ″		h. m. s.	° ′ ″
a	13 59 6.06	+71 2 41.5	*d*	14 6 36.10	+70 17 9.4
b	14 0 28.19	70 59 36.2	*e*	14 7 36.24	70 3 8.3
c	14 0 12.41	+70 43 58.8	*f*	14 7 16.67	+70 7 31.9

NINETEENTH ASTEROID.

1852.	Hamburg M. T.	(19) App. α	Log. Factor of Parallax.	(19) App. δ	Log. Factor of Parallax.	Comp.	Comparison-Stars.
	h. m. s.	° ′ ″		° ′ ″			
Oct. 24	7 16 30.1	329 57 20.2		−10 47 45.8	9.9549		Meridian-circle.
26	7 39 46.1	330 11 20.0		10 45 30.2	9.9548		Meridian-circle.
Nov. 6	6 23 35.7	332 15 8.0	9.0319 *n*	10 13 23.0	9.9520	5	*g*
12	8 58 19.0	333 11 26.5	9.5164	− 9 47 37.0	9.9432	6	*h*

Apparent Places of Comparison-Stars.

	App. α	App. δ		App. α	App. δ
	h. m. s.	° ′ ″		h. m. s.	° ′ ″
g	22 7 46.035	−10 20 49.3	*h*	22 12 46.418	−9 47 16.9

TWENTIETH ASTEROID.

1852.	Hamburg M. T.	(20) App. α	Log. Factor of Parallax.	(20) App. δ	Log. Factor of Parallax.	Comp	Comparison Stars.
	h. m. s.	° ′ ″		° ′ ″			
Oct. 26	8 32 33.8	355 54 16.8	9.1069 *n*	−1 26 56.7	9.9133	8	*i . k*
26	9 22 7.6	355 53 55.7		1 27 2.2	9.9134		Meridian-circle.
Nov. 6	8 7 31.3	355 10 46.4	8.8600 *n*	1 50 21.9	9.9154	4	*i*
6	8 36 0.2	355 10 41.2		1 50 15.6	9.9154		Meridian-circle.
12	9 35 8.6	355 9 31.5	9.3236	1 53 14.8	9.9152	8	*i . k*
13	8 8 28.5	355 10 38 ::		1 52 53.3	9.9157		Meridian-circle.
15	10 28 9.6	355 15 9.3	9.5527	1 51 59.8	9.9136	13	*i . k*
19	6 37 8.7	355 27 56.4	9.2190 *n*	1 47 56.8	9.9142	6	*i . k*
23	7 11 23.1	355 48 0.6	8.7211 *n*	1 40 22.0	9.9145	11	*i . k*
24	5 56 1.0	355 53 39.8	9.3671 *n*	−1 38 29.9	9.9137	5	*i . k*

Mean Places of Comparison-Stars for January 0, 1852.

	Mean α	Mean δ
	h. m. s.	° ′ ″
i	23 40 6.999	—1 34 58.9
k	23 40 36.898	—1 35 45.3

Elements of the twentieth asteroid, by George Rümker, from the Hamburg observations of September 30, October 26, and November 19.

M	297° 0′ 46″.0	1852, November 0, M. T. Berlin.
π	94 32 39.7	Mean Equinox, 1853, January 0.
☊	207 8 47.6	
i	0 40 28.1	
φ	10 3 27.5	
Log. *a*	0.3890493	
Log. μ	2.9661326	

An ephemeris of the planet extending to 1853, January 3, was also given in the same letter.

EUNOMIA.

1852.	Hamburg M. T.	⑮ App. α	Log. Factor of Parallax.	⑮ App. δ	Log. Factor of Parallax.	Comp.	Comparison Stars.
	h. m. s.	° ′ ″		° ′ ″			
Nov. 6	11 10 8.5	80 4 35.0	9.7335*n*	+37 30 50.1	9.5884	13	*p* . *q*
12	10 14 4.0	79 5 42.0	9.7787*n*	37 23 47.9	9.6271	4	*r* . *s*
13	9 11 23.3	78 54 37.7	9.8409*n*	37 22 6.6	9.7023	13	*t*
15	11 48 14.5	78 28 22.5	9.5194	37 17 23.3	9.5012	15	*u*
19	7 53 13.7	77 35 38.7	9.8659*n*	+37 6 14.3	9.7644	12	*v* . *w* . *z*

Apparent Places of Comparison-Stars.

*	App. α	App. δ	*	App. α	App. δ
	h. m. s.	° ′ ″		h. m. s.	° ′ ″
p	5 20 5.508	+37 31 18.9	*u*	5 14 39.519	+37 14 31.1
q	5 20 45.412	37 41 27.4	*v*	5 9 7.556	37 8 50.5
r	5 14 39.460	37 14 30.8	*w*	5 9 16.176	37 7 41.7
s	5 14 57.390	37 21 40.9	*z*	5 10 43.221	+37 16 54.7
t	5 14 57.400	+37 21 11.2			

OBSERVATIONS OF THE EIGHTEENTH ASTEROID, NEPTUNE, JUNO, AND THE NINETEENTH ASTEROID,

MADE WITH THE MERIDIAN-CIRCLE OF THE ALTONA OBSERVATORY.

By A. Sonntag.

[Communicated by Dr. Petersen.]

EIGHTEENTH ASTEROID.

1852.	M. T. Altona.	⑱ α	⑱ δ
	h. m. s.	° ′ ″	° ′ ″
July 15	10 16 49	268 5 12.6	—9 43 30.0
16	10 12 4	267 52 51.6	—9 49 16.5
17	10 7 20	267 40 48.3	

On July 17, the declination could not be read off on account of the great contraction of the bubble in the level, occasioned by the heat of the weather.

NEPTUNE.

1852.	M. T. Altona.	Ψ α	Ψ δ
	h. m. s.	° ′ ″	° ′ ″
Aug. 16	13 7 23	342 22 59.2	—8 28 24.5
19	12 55 18	18 36.6	30 16.9
21	12 47 14	15 36.7	31 29.9
22	12 43 12	14 8.1	32 5.2
23	12 39 10	12 38.7	32 45.3
27	12 23 2	342 6 35.4	35 16.3
Sept. 5	11 46 44	341 52 49.5	40 57.2
6	11 42 42	51 15.6	41 33.8
7	11 38 40	49 39.1	42 13.5
8	11 34 38	341 48 12.0	—8 42 47.5

JUNO.

1852.	M. T. Altona.	③ α	③ δ
	h. m. s.	° ′ ″	° ′ ″
Aug. 21	14 24 7	6 33 1.5	+2 48 53.4
27	13 59 38	6 19 31.5	+1 56 53.2
Oct. 3	11 14 56	1 30 21.9	—5 41 47.3

NINETEENTH ASTEROID.

1852.	M. T. Altona.	⑲ α	⑲ δ
	h. m. s.	° ′ ″	° ′ ″
Sept. 2	11 23 57	333 12 35.2	—8 33 25.7
3	11 19 10	332 59 45.0	38 59.9
5	11 9 37	34 31.5	50 6.1
6	11 4 52	22 9.6	8 55 31.9
7	11 0 7	9 55.2	9 0 59.1
8	10 55 24	57 58.2	—9 6 22.4

The observations of September 2, 3, and 5 differ somewhat from those given, *Astr. Nachr.*, No. 822, in consequence of a better determination of the elements for reduction.

FROM LETTERS OF DR. PETERSEN TO THE EDITOR.

Altona, 1852, *November* 21.

Professor Challis has sent me some observations of the Southern portion of Biela's Comet, made at Cambridge, England. They will be of interest to you.

1852.	Greenwich M. T.	R.A.	$\log \frac{p}{P}$	N. P. D.	No. of Comp.	Star.
	h. m. s.	h. m. s.		° ′ ″		
Sept. 8	16 0 36.8	8 43 36.80	—8.621	74 35 28.9	1	*a*
16	16 2 33.4	9 23 26.73 : :	—8.618	78 51 59.4	1	*b*
21	16 4 16.5	9 47 15.84	—8.615	81 37 48.2	1	*c*
	16 13 34.3	9 47 18.69	—8.613	81 38 6.2	7	*d*

Assumed Apparent Places of the Stars.

	R A.	N. P. D.	Name and Authority.
	h. m. s.	° ′ ″	
a	8 42 46.75	74 6 11.4	54 *Cancri* = B. A. C. 2995.
b	9 24 1.42	79 38 3.1	*h Leonis* = No. 833 of the Greenwich 12 Year Catalogue.
c	9 46 50.32	82 13 5.9	Weisse IX. 1011.
d	9 48 5.78	81 37 22.8	H. C. 19426 and 19427 = Weisse IX. 1035.

Altona, 1852, *December* 7.

The weather for some time past has been so unfavorable, that we have not been able to make a single observation of the two new planets, discovered in the middle of November, in Paris and London. I have only received three observations of *Lutetia* from Mr. Rümker, which are

1852.	M. T. Hamburg.	㉑ α	㉑ δ	No. Comp.
	h. m. s.	° ′ ″	° ′ ″	
Nov. 28	7 28 55.4	38 20 14.25	+12 24 30.0	5
29	6 23 26.3	38 11 4.50	12 23 5	2
Dec. 3	7 8 44.6	37 34 55.4	+20 5 6	

Mean Places of Comparison-Stars for 1852.0.

α	δ
h. m. s.	° ′ ″
2 27 9.01	+12 29 35.2
2 31 30.57	12 11 25.1
2 32 13.48	+12 15 30.1

Altona, 1852, *December* 10.

I have just received the following elements and ephemeris of *Lutetia* from Mr. G. Rümker, and elements of *Melpomene* by Mr. E. Vogel.

Observations of the Twenty-First Asteroid.

Elements of *Lutetia*, computed by G. Rümker, from observations at Paris, November 18, and Hamburg, November 28 and December 3.

1852, December 0.0, Berlin Mean Time.

M 61° 29′ 23″.3 }
π 309 53 19.4 } Mean Equinox, 1853.0.
☊ 78 38 48.4 }
i 3 19 49.7
φ 19 51 55.2
Log a 0.4157699
" μ 2.9263517

Ephemeris for Berlin Mean Midnight.

	㉑ α	㉑ δ	Log △
	m. s.	° ′	
1852, Dec. 6	2 28.18	+12 19.2	0.2104
7	28.21	19.1	
8	27.57	19.1	
9	27.35	19.3	
10	27.14	19.6	0.2230
11	26.55	20.0	
12	26.38	20.6	
13	26.23	21.3	
14	26.10	22.1	0.2361
15	25.59	23.0	
16	2 25.49	+12 24.1	
1852, Dec. 17	2 25.41	+12 25.3	
18	25.34	26.7	0.2490
19	25.29	28.2	
20	25.26	29.8	
21	25.25	31.5	
22	25.25	33.3	0.2630
23	25.27	35.2	
24	25.30	37.3	
25	25.35	39.5	
26	25.42	41.8	0.2767
27	25.50	44.2	
28	26.00	46.7	
29	26.11	49.4	
30	26.24	52.1	0.2904
31	26.38	55.0	
1853, Jan. 1	26.51	12 57.9	
2	27.12	13 1.0	
3	2 27.31	+13 4.1	0.3040

Elements III. of *Melpomene* by E. Vogel.

1852, July 10, $0^{h.}$ M. T. Greenwich.

M = 287° 3′ 46″.90 }
π = 15 15 10.16 } Mean Equinox, 1852.0.
☊ = 150 0 21.28 }
i = 10 9 2.23
φ = 12 30 14.67
Log e = 9.3354761
" a = 0.3607198
" μ = 3.0089269
μ = 1020″.76766

FROM A LETTER OF MR. HIND TO THE EDITOR.

Observatory, Regent's Park, London, 1852, *December* 17.

I have to announce to you my discovery of another new planet at $6^{h.}$ $30^{m.}$ M. T., on the 15th of this month. It shines like a star of 10.11 magnitude, with a pale bluish light. By micrometrical comparisons with Lalande 6129, I found the apparent positions as subjoined.

1852.	M. T. Greenwich.	α	N. P. D.
	h. m. s	h. m. s.	° ′ ″
Dec. 15	7 18 39.2	3 12 4.98	73 10 16.4
	8 42 2.0	3 12 2.70	73 10 3.9

whence the diurnal motion in R.A. is about —39ˢ, that in N. P. D. —3′.5.

Last night there was no chance of observing the planet; we had thunder and lightning, an unusual thing in London at this time of the year.

If I am the first discoverer of the planet, Mr. Bishop proposes to call it *Thalia*.

The one I found on November 16 has been named *Calliope* by Mr. Adams.

Mr. Vogel has calculated elements which may prove of service to American observers towards finding the planet, from observations on November 19, 24, and 30.

Epoch, 1852, December 0.0, Mean Time Greenwich.

M	22° 27′ 0″.5	Mean Equinox, 1852.0.
π	16 13 28.9	
Ω	66 53 6.1	
i	14 20 12.6	
φ	6 0 11.8	
Log a	0.4685289	
μ	703″.41748	

The expressions for the heliocentric coördinates are as follows, u being the argument of latitude: —

$$x = r\,[9.98844] \sin (u + 156^\circ\ 13'.1)$$
$$y = r\,[9.94451] \sin (u + \ \ 73\ \ 28.4)$$
$$z = r\,[9.72152] \sin (u + \ \ 44\ \ \ 2.6)$$

The weather has been exceedingly unfavorable for observations since I found this planet, not in England only, but apparently on the continent of Europe also.

J. R. HIND.

The following additional observation by Mr. G. Rümker has been received.

1852.	Hamburg M. T.	㉓ α	㉓ δ	No. Comp.	Comparison-Star.
	h. m. s.	° ′ ″	° ′ ″		
Dec. 18	9 54 9.2	47 31 46.1	+17 0 44.9	10	Rümker, No. 832.

TWENTY-SECOND ASTEROID.

OBSERVATIONS MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury.]

[Corrected for refraction.]

1852.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉒ — ∗		㉒'s apparent	
				Δα	Δδ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Dec. 17	7 40 44.4	2	B. Z. 396	—1 25.68	+3 28.01	4 42 27.31	+26 35 1.71
	9 8 5.7	10	"	—1 29.79	+3 37.84	4 42 23.20	+26 35 11.52
18	8 47 44.9	5	"	—2 28.15	+6 42.48	4 41 21.86	+26 38 19.23

Adopted Mean Place, 1850.0, *of Comparison-Star.*

α	δ
h. m. s.	° ′ ″
4 43 41.85	+26 31 16.89

The asteroid is estimated of the 9.6 magnitude.

OBSERVATIONS MADE AT MR. BISHOP'S OBSERVATORY, LONDON.

1852.	Greenwich M. T.	㉒ α	㉒ N. P. D.
	h. m. s.	h. m. s.	° ′ ″
Nov. 16	12 32 0	5 13 37.5	65 30 7.0
17	11 51 52	5 12 49.38	65 26 44.5
18	8 46 30	5 12 5.51	65 22 33.2

TWENTY-FIRST ASTEROID.

OBSERVATIONS MADE AT THE VIENNA OBSERVATORY.

[Communicated by Dr. PETERSEN.]

1852.	Vienna M. T.	㉑ App. α	Log. Factor of Parallax.	㉑ App. δ	Log. Factor of Parallax.	Comp	Observer.
	h. m. s.	h. m. s.		° ′ ″			
Dec. 4	8 40 45.1	2 29 49.82	8.027 *n*	12 20 0.5	9.771	3	HORNSTEIN.
5	7 6 26.1	2 29 18.45	8.429 *n*	12 19 49.8	9.787	4	
7	6 19 41.4	2 28 25.39	8.511 *n*	12 19 35.0	9.799	6	
9	7 30 31.5	2 27 37.56	8.295 *n*	12 20 1.2	9.777	6	

Mean Places of Comparison-Stars for 1852.0.

	α	δ	
	h. m. s.	° ′ ″	
Dec. 4 and 7	2 29 3.28	+12 15 32.0	B. Z. 126
5 and 9	2 27 59.80 2 28 10.02	+12 22 5.5 +12 17 44.5	By a meridian-circle observation and comparison with B. Z. 126.

OBSERVATIONS MADE AT PARIS.

1852.	Paris M. T.	㉑ α	㉑ δ
	h. m.	h. m. s.	° ′
Nov. 15	10 0	2 41 0	+12 34
16	11 45	2 40 5	12 32
17	10 30	2 39 55	+12 30

ELEMENTS AND EPHEMERIS OF IRIS, FOR 1854.

BY E. SCHUBERT.

[Communicated by Lieutenant C. H. DAVIS, Superintendent of the Nautical Almanac.]

THE integrated perturbations by *Jupiter* and *Saturn*, from 1848, January 1.0, to 1854, June 13.0, are,

	δ i	δ ☊	δ φ	δ π	δ μ	∫ δ μ	δ L	δ M
♃	−5′.78	− 301″.20	+ 72′.23	− 977″.48	−0″.44819	+ 356″.47	−40″.73	+ 936″.74
♄	+0.97	− 14.50	+ 0.23	+ 32.93	−0.00410	+ 15.10	−12.86	− 45.79
♃+♄	−4.81	−5′ 18.70	+1′ 12.16	−15 44.55	−0.45259	+6′ 11.57	−53.59	+14′ 50.95

OSCULATING ELEMENTS.

1854, June 13.0, M. T. Washington.

M	241° 13′ 55″.53	
i	5 28 12.32	
☊	259 45 58.31	M. Equinox, June 13.0.
π	41 15 49.31	M. Equinox, June 13.0.
φ	13 22 57.06	
μ	962″.41141	
Log. *a*	0.3777639	

Ephemeris for the Opposition.

12h. M. T. Washington.	⌓ α	⌓ δ	Log. *r*	Log. △
	h. m. s.	° ′ ″		
May 20	17 50 19.96	—23 42 25.8	0.443064	0.264489
21	49 34.48	40 38.5	.442815	.262596
22	48 47.60	38 48.9	.442565	.260751
23	47 59.36	36 57.1	.442314	.258956
24	47 9.79	35 3.1	.442063	.257212
25	46 18.93	33 6.8	.441809	.255520
26	45 26.83	31 8.2	.441555	.253883
27	44 33.53	29 7.2	.441299	.252302
28	43 39.08	27 3.9	.441041	.250778
29	42 43.54	24 58.3	.440783	.249311
30	41 46.97	22 50.3	.440524	.247904
31	40 49.43	20 39.9	.440263	.246558
June 1	39 50.96	18 27.1	.440001	.245274
2	38 51.64	16 11.9	.439738	.244053
3	37 51.51	13 54.4	.439473	.242895
4	36 50.65	11 34.6	.439207	.241802
5	35 49.11	9 12.4	.438940	.240774
6	34 46.95	6 48.1	.438671	.239811
7	33 44.26	4 21.5	.438401	.238916
8	32 41.07	23 1 52.8	.438130	.238089
9	31 37.45	22 59 21.9	.437858	.237329
10	30 33.48	56 48.9	.437584	.236638
11	29 29.21	54 13.9	.437310	.236017
12	28 24.71	51 37.1	.437034	.235464
☍ 13	27 20.06	48 58.5	.436756	.234982
14	26 15.31	46 18.1	.436478	.234570
15	25 10.60	43 36.1	.436198	.234227
16	24 5.91	40 52.7	.435916	.233956
17	23 1.33	38 7.8	.435634	.233755
18	21 56.93	35 21.6	.435351	.233625
19	20 52.79	32 34.2	.435066	.233565
20	19 48.99	29 45.9	.434779	.233576
21	18 45.59	26 56.8	.434492	.233657
22	17 42.65	24 7.0	.434203	.233808
23	16 40.25	21 16.7	.433913	.234028
24	15 38.48	18 26.2	.433622	.234318
25	14 37.40	15 35.3	.433329	.234675
26	13 37.06	12 44.5	.433035	.235099
27	12 37.54	9 53.8	.432740	.235591
28	11 38.88	7 3.5	.432443	.236148
29	10 41.16	4 13.7	.432145	.236770
30	9 44.43	22 1 24.6	.431847	.237456
July 1	8 48.75	21 58 36.4	.431547	.238204
2	7 54.17	55 49.1	.431245	.239014
3	7 0.75	53 3.0	.430942	.239883
4	6 8.52	50 18.4	.430638	.240812
5	5 17.53	47 35.4	.430332	.241799
6	4 27.86	44 54.1	.430026	.242842
7	17 3 39.55	—21 42 14.6	0.429718	0.243939

☍ 1851, June 13, 6h. 10m. 13s..0, M. T. Washington.

Mean Longitude,	262° 32′ 28″.2
Geocentric Latitude,	+ 0 25 22.6
Heliocentric Latitude,	+ 0 15 56.6
Intensity of Light,	0.496

LETTER OF PROFESSOR ALEXANDER TO THE EDITOR.

Princeton, 1852, *November* 20.

I FIND that I have committed an oversight in the statement which I made in the note at the conclusion of my paper in No. 11 of the *Astronomical Journal*. The observations there referred to are not those of the same star; and both the objects in question were first observed by Mr. HIND. Mr. HIND has himself corrected my mistake (*Astronomische Nachrichten*, 832). Will you be so good as to repeat the correction in the *Astronomical Journal*, at some time when you have room for it.

STEPHEN ALEXANDER.

NEW WORKS.

Stellarum Fixarum imprimis Duplicium et Multiplicium Positiones Mediæ pro Epocha 1830.0, *deductæ ex Observationibus Meridianis Annis* 1822 *ad* 1843 *in Specula Dorpatensi institutis. Auctore* F. G. W. STRUVE. Petropoli, 1852. — This volume is the third and final one of the series containing the results of STRUVE's labors at Dorpat. The first, the *Catalogus Novus Stellarum Duplicium, etc.*, was published in 1827, and gave the approximate places of 3110 double and multiple stars, of which 2390 were not previously known as such; the second, the *Mensuræ Micrometricæ, etc.*, published in 1837, gave, in connection with the *Additamentum*, published in 1840, the *relative* positions of the components of these systems as determined by means of the Dorpat telescope between the years 1824 and 1838. The present volume completes the labor by giving the *absolute* places of these stars as determined by meridian observations at Dorpat; and it is characterized throughout by that accuracy of observation and completeness of method in reduction which have rendered the previous works of that Observatory so valuable.

The Introduction, occupying 254 pages, gives the description of the observations, the methods of reduction, the constants employed, &c., &c., offering a highly important treatise for the study of astronomers; then follow five special catalogues for the epochs 1824, 1828, 1832, 1836, and 1840, and, finally, in the General Catalogue, embodying the previous results, are given the places of 2871 stars, reduced to 1830.0. The whole work forms a most valuable contribution to stellar astronomy, and claims our highest confidence.

Sur les Dimensions des Anneaux de Saturne. Par M. OTTO STRUVE. (*Extrait des Mémoires de l'Académie des Sciences de St. Pétersbourg*, VI. *Série.*) St. Petersbourg, 1852. — The measurements of the dimensions of *Saturn's* rings, of which the results are given in this essay, were undertaken by M. OTTO STRUVE, in consequence of a suspicion of change of dimensions of the dark interior ring, and to furnish for the given epoch a complete table of dimensions for the whole system. With respect to changes in the system his conclusions are: — 1. The interior edge of the rings approaches constantly to the globe of the planet. 2. The approach of the interior edge is combined with an increase of the total breadth of the rings. 3. In the interval between the observations of J. D. CASSINI and W. HERSCHEL, the breadth of the (interior bright) ring *B* has increased in a more rapid ratio than that of the (exterior) ring *A*.

Exposé Historique des Travaux exécutés jusqu'a la fin de l'Année 1851 *pour la Mésure de l'Arc du Méridien entre Fuglenæs* 70° 40′ *et Ismaïl* 45° 20′. *Par* W. STRUVE. *Suivi de deux Rapports de* M. G. LINDHAGEN, *sur l'Expédition de Finmarken en* 1850, *et sur les Opérations de Lapponie executées en* 1851. St. Pétersbourg, 1852. — Astronomers will receive with great satisfaction the announcement of the completion of that immense undertaking, the measurement of the Russian-Scandinavian arc of the meridian. This arc, the measurement of which was commenced in 1816, extends from a point near the town of Hammerfest, on the island of Qual-oe in the Northern Ocean, to a signal about ten wersts eastward of the fortress of Ismaïl, on a branch of the Danube. The publication of the details of the work will be looked for with great interest, and it is much to be hoped that it may not be long delayed.

G.

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THE
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No. 53.

VOL. III. CAMBRIDGE, 1853, FEBRUARY 11. NO. 5.

ON THE LONGITUDES OF KEY WEST, CEDAR KEYS, AND ST. MARK'S, FLORIDA.

LETTER FROM PROFESSOR BACHE TO THE EDITOR.

Coast Survey Office, 1853, *January* 14.

I HAVE the honor to send to you, for insertion in the *Astronomical Journal*, a report by Assistant J. E. HILGARD, of the United States Coast Survey, on the longitudes of Key West, Cedar Keys, and St. Mark's, Florida, as determined by chronometers. As these results differ from those generally received, it is deemed advisable to give them publicity at once. The publication is duly authorized by the Treasury Department.

A. D. BACHE,
Superintendent U. S. Coast Survey.

LETTER FROM MAJOR STEVENS.

Office Coast Survey, 1852, *December* 24.

DEAR SIR: —

THE chronometric expedition under the charge of Mr. HILGARD during the months of February, March, and April last, for the determination of the longitudes of Key West, Cedar Keys, and St. Mark's, gives the following results. I also insert in the table the latitude of the several stations.

Station.	Latitude.	Longitude.
Key West Light,	24° 32′ 58″	81° 48′ 7″
Sand Key Light,*	21 27 10	81 52 43
Depot Key,	29 7 30	83 2 45
St. Mark's Light,	30 4 25	84 10 37

* In progress of construction.

Ten chronometers were used, and the result of each is given in Mr. HILGARD's report to me of 10th December, a copy of which is herewith inclosed.

In the same report may also be found interesting comparisons of the longitudes obtained by this expedition, with those given by other authorities.

Yours respectfully,
ISAAC I. STEVENS,
Assistant in Charge of Office.

PROFESSOR A. D. BACHE,
Superintendent U. S. Coast Survey.

REPORT ON THE LONGITUDE OF KEY WEST, CEDAR KEYS, AND ST. MARK'S.

Office Coast Survey, 1852, *December* 10.

DEAR SIR: —

I SUBMIT the following report on the longitudes of Key West, Cedar Keys, and St. Mark's, as determined by the chronometric expedition under my charge during the months of February, March, and April of this year.

The station of reference is Professor GIBBES's Observatory in Charleston, the longitude of which is at present assumed $5^{h.}\ 19^{m.}\ 44^{s}.0$ west of Greenwich. At Key West the transit was mounted at a point $17^{s}.25$ east of the station on Sand Key, at which moon-culminations were observed in 1849. The station at the Cedar Keys is the trigonometrical point on Depot Key. At St. Mark's the transit was $7^{s}.50$ west of the Lighthouse.

Eleven chronometers were carried, one of which, a worn-out one, is rejected throughout, its performance being entirely unsatisfactory. We have therefore for each trip ten results, of which the following is a tabular statement: —

Differences of Longitude by Chronometers.

Key West west of Charleston.		Depot Key west of Key West.	St. Mark's west of Key West.
Charleston — Key West.	Key West — Charleston.		
m. s.	m s	m. s	m. s
7 28.0	7 30.7	4 55.2	9 37.5
25.1	30.5	55.7	39.6
28.6	28.6	57.3	36.9
31.6	27.5	57.7	36.1
32 0	31.7	57.6	34.6
29.5	28.6	57.3	37.3
26.8	28.6	56.6	38.6
31.0	28.2	58.7	31.9
32.9	32.6	58.5	34.3
7 31.5	7 29.0	4 58.8	9 36.5
7 29.70	7 29.60	4 57.34	9 36.33
7ᵐ· 29ˢ·.65 ± 0ˢ.30		±0.25	± 0.48

From these results and the data mentioned above we obtain the following longitudes west of Greenwich.

	h. m. s.
Charleston Observatory,	5 19 44.00
Key West transit (west of Charleston, 7ᵐ· 29ˢ·.65),	5 27 13.65
Sand Key (west of Key West transit, 17ˢ·.25),	5 27 30.90
Depot Key (west of Key West transit, 4ᵐ· 57ˢ·.34),	5 32 10.99
St. Mark's (west of Key West transit, 9ᵐ· 36ˢ·.33),	5 36 19.98
St. Mark's Light (east of St. Mark's transit, 7ˢ·.50),	5 36 42.48

For Sand Key, Mr. S. C. Walker obtained 5ʰ· 27ᵐ· 31ˢ.6, from some of the moon-culminations observed there. The value deduced from the longitude of Moro Castle, Havana, is 5ʰ· 27ᵐ· 28ˢ·.0, subject to the uncertainty of the correction to the moon's horizontal parallax. The value above obtained is undoubtedly to be preferred.

The longitude of Depot Key given on Blunt's Chart is 82° 56′ or 5ʰ· 31ᵐ· 44ˢ, being 27ˢ· too far east.

That of St. Mark's Light is given in Bowditch's Navigator 84° 20′ or 5ʰ· 37ᵐ· 20ˢ, or 37ˢ·.5 too far west, the difference of longitude between Depot Key and St. Mark's being too great by 61ˢ·.5 according to those authorities. Mr. Blunt had already corrected the longitude of St. Mark's from 84° 55′, as given by Gauld's Chart, to 84° 20′. It appears, therefore, that a more accurate determination of these longitudes was much needed, and is an important addition to geographical knowledge.

I subjoin a table of results: —

Station.	Latitude.	Longitude
	° ′ ″	° ′ ″
Key West Light,	24 32 58	81 48 7
Sand Key Light,*	24 27 10	81 52 43
Depot Key,	29 7 30	83 2 45
St. Mark's Light,	30 4 25	84 10 37

* In progress of construction.

Yours respectfully,

J. E. HILGARD.

MAJOR I. I. STEVENS,
Assistant in Charge.

TWENTY-THIRD, TWENTY-SECOND, AND TWENTY-FIRST ASTEROIDS.

Dr. Petersen, under date of January 4, has communicated the following information respecting these planets: —

TWENTY-THIRD ASTEROID.

Elements and Ephemeris, — Computed by Mr. Bruhns, from observations at London, Dec. 15, Berlin, Dec. 22 and 29. Epoch, 1852, December 22.373624, M. T. Berlin.

L_0	88° 30′ 58″.8	Mean Equinox, January 0, 1853.
M_0	325 45 0.9	
π	122 45 57.9	
☊	67 46 59.0	
i	10 21 33.0	
φ	14 53 43.3	
Log. a	0.432550	
" μ	2.901182	

Ephemeris for 12h. *Berlin Mean Time.*

1853.	㉓ α	㉓ δ	Log △
	h. m. s.	° ′	
Jan. 0	3 5 26	+17 56.6	0.1584
1	5 20	18 1.4	
2	5 16	6.4	
3	5 14	11.5	
4	5 13	16.6	0.1674
5	5 15	21.8	
6	5 19	27.2	
7	5 25	32.7	
8	5 33	38.2	0.1768
9	5 44	43.8	
10	5 57	49.5	
11	6 12	18 55.3	
12	6 29	19 1.2	0.1865
13	3 6 48	+19 7.1	
Jan. 14	3 7 10	+19 13.1	
15	7 34	19.2	
16	7 59	25.4	0.1963
17	8 26	31.6	
18	8 56	37.9	
19	9 28	44.2	
20	10 2	50.6	0.2063
21	10 38	19 57.1	
22	11 15	20 3.7	
23	11 54	10.3	
24	12 35	17.0	0.2163
25	13 18	23.7	
26	14 3	30.4	
27	14 50	37.2	
28	3 15 38	20 44.0	0.2262

Observations. — 1. At Berlin.

1852.	M. T. Berlin.	㉓ α	㉓ δ	No. of Obs.
	h. m. s.	° ′ ″	° ′ ″	
Dec. 21	9 48 0.3	47 7 35.5	+17 12 2.1	13
22	8 58 1.1	47 1 2.2	17 15 52.0	10
23	7 8 0.4	46 55 2.7	17 19 36.7	12
24	7 27 3.7	46 48 52.5	17 23 48.7	10
29	10 10 56.9	46 26 29.2	+17 46 39.0	10

2. At Vienna by Hornstein.

1852.	M. T. Vienna.	㉓ App. α	Log. Factor of Parallax.	㉓ App. δ	Log. Factor of Parallax.	No. of Obs.	Comp. Star.
	h. m. s.	h. m. s.		° ′ ″			
Dec. 29	8 7 15.9	3 5 46.61	7.705 *n*	+17 46 12.9	9.705	3	*a*
	8 52 38.1	46.16	7.616 *n*	25.7	9.705	3	*a*
	9 5 45.5	3 5 46.33	7.833 *n*	+17 46 22.3	9.706	2	*b*

Mean Places of Comparison-Stars for 1852.0.

	α	δ	
	h. m. s.	° ′ ″	
a	3 5 42.79	+17 45 25.3	Lalande 5967 and B. Z. 506.
b	3 2 20.03	+18 10 41.6	Lalande 5855, B. Z. 506, and Rümker 798.

The declination of both stars is taken from Lalande.

TWENTY-SECOND ASTEROID.

Elements and Ephemeris, — Computed by Hornstein, from observations at London, November 17, and Vienna, December 3 and 21.

1852, December 4, 0h. M. T. Berlin.

M	13° 6′ 19″.0	
π	58 43 55.0	Mean Equinox,
☊	66 41 23.2	1853, January 1.
i	13 54 6.1	
φ	5 44 39.08	
Log. *a*	0.4643256	
" μ	2.8535182	
e	0.1000872	

Ephemeris for 0h. *Berlin Mean Time.*

1853.	㉒ α	㉒ δ	Log △
	h. m. s.	° ′	
Jan. 0	4 30 49	+27 12.2	0.2414
1	30 7	14.6	
2	29 27	17.0	
3	28 48	19.4	
4	28 12	21.7	0.2489
5	27 36	24.0	
6	27 3	26.3	
7	26 32	28.5	
8	4 26 2	+27 30.7	0.2571

1853.	㉒ α h. m. s.	㉒ δ ° ′	Log △	1853.	㉒ α h. m. s.	㉒ δ ° ′	Log △
Jan. 9	4 25 31	+27 32.9		Jan. 21	4 22 29	+27 59.3	
10	25 8	35.1		22	22 26	28 1.5	
11	24 44	37.3		23	22 25	3.8	
12	24 22	39.5	0.2660	24	22 26	6.0	0.2951
13	24 2	41.7		25	22 29	8.3	
14	23 44	43.9		26	22 33	10.5	
15	23 27	46.1		27	22 40	12.8	
16	23 13	48.3	0.2753	28	22 48	15.0	0.3054
17	23 0	50.5		29	22 58	17.3	
18	22 50	52.7		30	23 10	19.6	
19	22 41	54.9		31	23 24	22.0	
20	4 22 31	+27 57.0	0.2851	Feb. 1	4 23 39	+28 24.3	0.3158

Observations. — At Vienna by Hornstein.

1852.	M. T. Vienna. h. m. s.	㉒ App. α h m. s.	Log. Factor of Parallax.	㉒ App. δ ° ′ ″	Log. Factor of Parallax.	No. of Obs.	Comparison Stars.
Dec. 3	7 33 50.3	4 57 27.86	8.661 *n*	25 43 54.2	9.752	4	*a . b*
5	7 43 31.8	55 19.22	8.644 *n*	51 53.2	9.733	4	*a . d*
7	7 3 17.7	53 12.37	8.671 *n*	25 59 29.4	9.759	4	*a . e*
9	8 53 7.7	50 58.45	8.509 *n*	26 7 20.1	9.651	6	*a . e*
19	6 4 51.7	40 48.03	8.673 *n*	40 21.7	9.753	6	*f*
22	6 11 11.5	4 38 53.75	8.659 *n*	26 46 15.8	9.737	6	*f*

Mean Places of Comparison-Stars for 1852.0.

	α h. m. s.	δ ° ′ ″	
a	4 50 31.26	+25 42 35.2	Lalande 9326 and B. Z. 396.
b	52 29.77	25 44 44.3	2 Observations with Meridian-Circle.
c	54 19.12	25 33 6.8	B. Z. 396.
d	56 44.12	26 13 18.8	Piazzi IV. 287 and Taylor 1808.
e	52 34.08	26 26 49.3	Rümker 1346.
f	4 39 56.07	+26 44 51.8	Lalande 9003 and B. Z 396.

TWENTY-FIRST ASTEROID.

Observations. — At Vienna by Hornstein.

1852.	M. T. Vienna. h. m. s.	㉑ App. α h. m. s.	Log. Factor of Parallax.	㉑ App. δ ° ′ ″	Log. Factor of Parallax.	No. of Obs.
Dec. 10	7 19 38.8	2 27 17.38	8.320 *n*	+12 20 26.6	9.780	6
12	7 32 8.6	2 26 41.60	8.233 *n*	+12 21 43.7	9.776	4

Mean Places of Comparison-Stars for 1852.0.

α h. m. s.	δ ° ′ ″
2 29 3.28	+12 15 32.0
2 28 10.02	+12 17 44.5

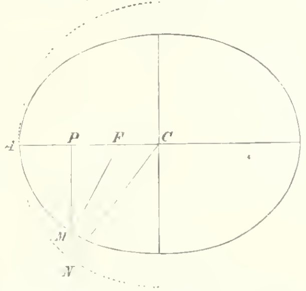
On the 12th there was a wind from the east during the observation, and a sensible tremor of the telescope.

A NEW METHOD OF SOLVING KEPLER'S PROBLEM.

By E. SCHUBERT.

In computing the perturbations and ephemeris of *Iris*, I often felt the want of a more direct, and perhaps shorter, method for deriving the true anomaly from the mean. I take the liberty of submitting to the judgment of astronomers, in the following article, the results of trials made for this purpose, in the hope that a more experienced hand may improve upon them.

Instead of the common mean anomaly in arc, I introduce the elliptical sectors described proportionally to the time, and express them as functions of x (abscissa on the major axis, reckoned from the center of the ellipse).



The elliptical sector $A\,F\,M$ is the sum of the elliptical segment $A\,M\,P$ and the triangle $M\,P\,F$.

If we put $a = 1$, the elliptical segment $A\,M\,P$ is,

$$\frac{b'\pi}{4} - b' \int_{x=0}^{x=CM} \sqrt{(1-x^2)}\, d\,x,$$

and the triangle $M\,P\,F$

$= \frac{b'}{2} \sqrt{(1-x^2)}\,(x-e)$; e denoting the eccentricity, so that the general elliptical sector is

$$S = \frac{b'\,\pi}{2.2} - \frac{b'}{2}\, x \sqrt{(1-x^2)} - \frac{b'}{2} \sin^{-1} x + \frac{b'}{2} \sqrt{(1-x^2)}(x-e).$$

$$\begin{aligned} \frac{2\,S}{b'} - \frac{\pi}{2} &= \sqrt{(1-x^2)}\,(x-e) - x\sqrt{(1-x^2)} - \sin^{-1} x \\ &= P = -e\sqrt{(1-x^2)} - \sin^{-1} x \qquad (1.) \end{aligned}$$

This equation is, as easily can be seen, identical with

$$M = E - e \sin E,$$

if we write it

$$\frac{2\,S}{b'} = \frac{\pi\,M}{180} = \cos^{-1} x - e \sqrt{(1-x^2)}\,.$$

If we now substitute the infinite series for the two terms in the second member of (1); and because

$$S = b'\,\pi \frac{M}{360},$$

M denoting the mean anomaly in arc, we have

$$\pi\left(\frac{M}{180} - \frac{1}{2}\right) + e = Q = -x + \frac{e}{2} x^2 - \frac{x^3}{6} + \frac{e}{8} x^4 - \&c. \qquad (2.)$$

We invert this series, and put

$$x = a\,Q + b\,Q^2 + c\,Q^3 + d\,Q^4 + e'\,Q^5 + f\,Q^6 + \&c.,$$

and obtain for the determination of the coefficients a, b, &c., the following equations: —

$$\begin{aligned} -x &= -a\,Q - b\,Q^2 - c\,Q^3 - d\,Q^4 - e'\,Q^5 - f\,Q^6 - \&c. \\ +\frac{e}{2}\,x^2 &= +\frac{e}{2} a^2\,Q^2 + e\,a\,b\,Q^3 + \frac{e}{2}(2\,a\,c + b^2)\,Q^4 + \&c. \\ -\frac{x^3}{6} &= -\frac{a^3}{6}\,Q^3 - \tfrac{1}{2}\,a^2\,b\,Q^4 - \tfrac{1}{2}\,(a^2\,c + a\,b^2)\,Q^5 - \&c. \\ +\frac{e}{8}\,x^4 &= +\frac{e}{8} a^4\,Q^4 + \tfrac{1}{2}\,e\,a^3\,b\,Q^5 + e\left(\frac{a^3 c}{2} + \tfrac{3}{4}\,a^2\,b^2\right)Q^6 + \&c. \\ -\tfrac{3}{40}\,x^5 &= -\tfrac{3}{40}\,a^5\,Q^5 - \tfrac{15}{40}\,a^4\,b\,Q^6 - \&c. \\ +\frac{e}{16}\,x^6 &= +\frac{e}{16}\,a^6\,Q^6 + \&c. \end{aligned}$$

hence,

$$\begin{aligned} a &= -1 \\ b &= +\frac{e}{2} \\ c &= -\frac{e}{2} + \tfrac{1}{6} \\ d &= +\tfrac{5}{8}\,e^3 - \tfrac{7}{24}\,e \\ e' &= -\tfrac{7}{8}\,e^4 + \tfrac{1}{2}\,e^2 - \tfrac{1}{120} \\ f &= +\tfrac{21}{16}\,e^5 - \tfrac{7}{8}\,e^3 + \tfrac{31}{720}\,e \end{aligned}$$

so that the inverted series is

$$\begin{aligned} x = -Q + \frac{e}{2}\,Q^2 - \left(\frac{e^2}{2} - \tfrac{1}{6}\right)Q^3 + \left(\tfrac{5}{8}\,e^3 - \tfrac{7}{24}\,e\right)Q^4 \\ -\left(\tfrac{7}{8}\,e^4 - \frac{e^2}{2} + \tfrac{1}{120}\right)Q^5 + \left(\tfrac{21}{16}\,e^5 - \tfrac{7}{8}\,e^3 + \tfrac{31}{720}\,e\right)Q^6. \end{aligned} \qquad (3.)$$

When x is thus found, and $\sqrt{(1-x^2)}$ taken out of the tables as cosine corresponding to x as sine, we have

$$\begin{aligned} P\,M &= r \sin v = b' \sqrt{(1-x^2)} \\ F\,M &= r \cos v = x - e \\ \sin E &= \sqrt{(1-x^2)} \\ \cos E &= x. \end{aligned} \qquad (4.)$$

Whereby v, r (in units of the major semi-axis), and E, become known.

But this series can furnish a value of x sufficiently exact only within certain limits, and is of no great practical interest. Therefore we resume the equation (1), and solve it by trials. For this purpose, we substitute in (1) an approximate x (the method of finding which I shall show below); take from a table the negative $\sin^{-1} x$, and add the negative cosine multiplied by e. This sum will give a value P', different from P. If we put now $P - P' = \delta\,P'$, and differentiate, we have

$$\delta\,P = \frac{e\,x - 1}{\sqrt{(1-x^2)}}\,\delta\,x\text{, and}$$

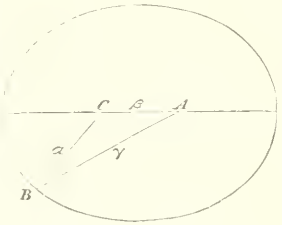
$$\delta\,x = \frac{\sqrt{(1-x^2)}}{e\,x - 1}\,\delta\,P' \text{ as the correction of } x.$$

In this manner, x found by means of (3) can be corrected where it is necessary. The substitution of this corrected x, and the repeated correction following from that, will be sufficient in most cases, provided the first substituted value were not too much out of the way.

When $x = 0$, then $P = -e$, and x, as well as $\sin^{-1} x$, is negative for P within the limits $+\frac{1}{2}\pi$ and $-e$. When the mean anomaly is greater than 180°, the calculation is to be made with $360° - M$.

To find an approximate x for the beginning, we will make use of a known property of the ellipse; namely, if we suppose one of the radii vectores to turn uniformly about one of the foci (describing therefore the mean anomaly), the other radius-vector will then, in not very eccentric ellipses, describe nearly the true anomaly.

We will now first solve generally, and by trigonometry, the problem,



If in a triangle, one side, one adjacent angle, and the sum of the other sides, are given, to find the other adjacent angle.

Given the angle A, the side B, and the sum $\alpha + \gamma$ to find the angle C.

We put

$s = \frac{1}{2}(\alpha + \beta + \gamma)$, and we have, as is well known,

$$\sin \tfrac{1}{2} A = \sqrt{\frac{(s-\beta)(s-\gamma)}{\beta\gamma}}. \qquad \sin \tfrac{1}{2} C = \sqrt{\frac{(s-\alpha)(s-\beta)}{\alpha\beta}}.$$

$$\cos \tfrac{1}{2} A = \sqrt{\frac{s(s-\alpha)}{\beta\gamma}}. \qquad \cos \tfrac{1}{2} C = \sqrt{\frac{s(s-\gamma)}{\alpha\beta}}.$$

therefore,

$$\text{tang}^2 \tfrac{1}{2} C = \frac{(s-\beta)(s-a)}{s(s-\gamma)}, \qquad \text{tang}^2 \tfrac{1}{2} A = \frac{(s-\beta)(s-\gamma)}{s(s-\alpha)},$$

$$\text{tang}^2 \tfrac{1}{2} A \frac{s}{s-\beta} = \frac{s-\gamma}{s-a} = p$$

$$\text{tang}^2 \tfrac{1}{2} C \frac{s}{s-\beta} = \frac{s-a}{s-\gamma} = \frac{1}{p} = q,$$

and

$$\frac{\text{tang}^2 \frac{1}{2} C}{\text{tang}^2 \frac{1}{2} A} = \frac{(s-a)^2}{(s-\gamma)^2}, \text{ or } \text{tang} \tfrac{1}{2} C = \frac{\text{tang} \frac{1}{2} A}{p} = \frac{s-\beta}{s \,.\, \text{tang} \frac{1}{2} A}.$$

Now α and γ can be found algebraically; since

$$\frac{s-a}{s-\gamma} = q\,,\ \alpha + \gamma = \Sigma,\ \gamma = \Sigma - \alpha,$$

$$\frac{s-a}{s-\Sigma+a} = q\,,\ s + q\,(\Sigma - s) = \alpha\,(1+q),$$

$$\alpha = \frac{s + q\,(\Sigma - s)}{1+q}.$$

If we apply this to the ellipse, then A is the mean anomaly M, $C = 180° - v$, α the radius-vector r, $s = \frac{1}{2}(\alpha + \beta + \gamma) = a' + e$, and $\Sigma - s = a - e$, hence

$$r = \frac{a' + e + q(a' - e)}{1+q}; \quad \text{or since } q = \frac{a'+e}{a'-e} \text{tang}^2 \tfrac{1}{2} C,$$

$$r = \frac{(a'+e)\sec^2 \frac{1}{2} C}{1+e} = \frac{b'^2 \sec^2 \frac{1}{2} C}{(a'-e)+(a'+e)\,\text{tang}^2 \frac{1}{2} C}$$

$$= \frac{b'^2}{(a'+e)\sin^2 \frac{1}{2} C + (a'-e)\cos^2 \frac{1}{2} C}.$$

We had, in (4), $x - e = r \cos v$; if we substitute in this the expression found for x, and multiply by $-\cos C$ instead of $\cos v$, we obtain

$$x - e = \frac{b'^2 \sec^2 \frac{1}{2} C\,(-\cos^2 \frac{1}{2} C + \sin^2 \frac{1}{2} C)}{(a'-e) + (a'+e)\,\text{tang}^2 \frac{1}{2} C}$$

$$= \frac{b'^2\,(\text{tang}^2 \frac{1}{2} C - 1)}{(a'-e) + (a'+e)\,\text{tang}^2 \frac{1}{2} C}.$$

But

$$\text{tang} \tfrac{1}{2} C = \frac{s-\beta}{s\, \text{tang} \frac{1}{2} A} = \frac{a'-e}{(a'+e)\,\text{tang} \frac{1}{2} M}.$$

By substituting this and reducing, we find

$$x - e = \frac{b'^2\,(a'-e)^2 - b'^2\,(a'+e)^2\,\text{tang}^2 \frac{1}{2} M}{(a'+e)\,(a'-e)^2 + b'^2\,(a'+e)\,\text{tang}^2 \frac{1}{2} M}$$

$$= \frac{(a'-e)^2 - (a'+e)^2\,\text{tang}^2 \frac{1}{2} M}{a' - e + (a'+e)\,\text{tang}^2 \frac{1}{2} M}$$

and thus an approximate x.

The most practical method, however, of solving our equation is by means of a table, such as I have constructed from 10′ to 10′, and used in computing the ephemeris of *Iris* for 1854 and 1855. It is of the following form: —

	$\sin^{-1} x$	$\cos = \sqrt{(1-x^2)}$	$\sin = x$		
0° 0′	0.0000000	1.0000000	0.0000000	1.5707963	0′ 90°
25 0	0.4363323	0.9063078	0.4226183	1.1341640	0 65
45 0	0.7853982	0.7071068	0.7071068	0.7853982	0 45
		$\sin = x$	$\cos = \sqrt{(1-x^2)}$	$\sin^{-1} x$	

When an approximate x is found by means of the above formula, or, since this approximation is not always near enough to show in the table the two including P, when the place of P in the table has been ascertained by a few simple trials, the two including sums $-\sin^{-1} x - e\sqrt{(1-x^2)}$ are to be obtained, and x simply interpolated, which in most cases with a table from 10′ to 10′ will be correct in six decimal places. If great accuracy is required, the correction of x is easily obtained by means of the differential formula given above. In case of x being nearly $= 1$, $\sqrt{(1-x^2)}$ is to be interpolated, and the correction $\delta \sqrt{(1-x^2)}$ is then equal to $-\frac{x\,\delta P}{e x - 1}$.

When x is to be found for a series of P with constant intervals, it is only necessary to compute the first P, since the following P can be formed by adding or subtracting $\frac{\Delta M}{180} \cdot \pi$. Many facilities will be discovered by the computer as soon as he becomes familiar with this method. When, in forming the arguments P, one gets beyond the aphelion, so that $'P$ is greater than $\frac{\pi}{2}$, the next P (in order to obtain $360° - v$) is $= \pi - {}'P$, and when going through the perihelion $= -\pi - {}'P$.

To give an example in illustration, let

$a' = 1$; $\log a'$ (in units of the mean distance of the earth) $= 0.3776819$
$\log b' = 9.9881311$ $(1-e)^2 = 0.5920$ $\log(1+e)^2 = 0.1802$
$\log e = 9.3628687$ $1-e = 0.7694$ $\log(1+e) = 0.0901$
$e = 0.2306050$

and we shall derive E, v, and r for the mean anomalies 10°, 100°, 190°, and 280°. The first P is $= -\frac{4}{9}\pi$, and the variation of P for 90° variation of the mean anomaly $= \pm\frac{\pi}{2} = \pm 1.5707963$.

	$M = 10°$.		$= 190°$.		$= 100°$		$= 280°$.	
P	—1.3962634		+1.3962634		+0.1745329		—0.1745329	
$\tan^2 \frac{1}{2} M = m$		7.8839		2.1161		0.1524		9.8476
$-(1+e)^2 m$	—0.0116	8.0641*u*	—197.9	2.2963*u*	—2.151	0.3326*u*	—1.066	0.0279*u*
$(1+e)\, m$	+0.0094	7.9740	+160.8	2.2062	+1.748	0.2425	+0.866	9.9377
$(1-e)^2-(1+e)^2 m$	+0.5804	9.7637	—197.3	2.2950*u*	—1.559	0.1928*u*	—0.474	9.6760*u*
$(1-e)+(1+e)\, m$	+0.7788	9.8914	+161.5	2.2083	+2.517	0.4009	+1.636	0.2137
$x - e$	+0.745	9.8723	— 1.221	0.0867	—0.619	9.7919*u*	—0.290	9.4623*u*
Approximate x	+0.976		— 0.990		—0.388		—0.059	
Interp. x	+0.9745107	9.9887	—0.9899467	9.9956*u*	—0.3783343	9.5778*u*	—0.0556853	8.7157*u*
or	+77° 2′ 9″.09		—81° 52′ 7″.73		22° 13′ 50″.00		—3° 11′ 31″.87	
$\sqrt{(1-x^2)}$	+0.2243412	9.3509	+0.1414401	9.1505		9.9664		9.9993
$-e\sqrt{(1-x^2)}$	—0.0517342	8.7137*u*	—0.0326168	8.5134*u*	—0.2134639	9.3293*u*	—0.2302472	9.3621*u*
$\sin^{-1} x$	—1.3445293		—1.4288803		+0.3879961		+0.0557141	
P'	—1.3962635		+1.3962635		+0.1745325		—0.1745331	
$P - P' = \delta P'$	+ 1	3.0000	— 1	3.0000*u*	+ 4	3.6021	+ 2	3.3010
$-x$ or $\sqrt{(1-x^2)}$		9.9888*u*		9.9956		9.9665		9.9993
		2.9888*u*		2.9956*u*		3.5686		3.3003
$e\,x$	+0.2247	9.3517	—0.2283	9.3585*u*	—0.0872	8.9407*u*	—0.0128	8.1086*u*
$e\,x - 1$	—0.7753	9.8895*u*	—1.2283	0.0893*u*	—1.0872	0.0363*u*	—1.0128	0.0055*u*
$\delta\sqrt{(1-x^2)}$ or δx	+ 1	3.0993	+ 1	2.9063	— 3	3.5323*u*	— 2	3.2948*u*
$x = \cos E$	+0.9745107	9.9887	—0.9899467	9.9956*u*	—0.3783346	9.5778*u*	—0.0556855	8.7457*u*
$\sqrt{(1-x^2)} = \sin E$	+0.2243413	9.3509	+0.1414402	9.1505		9.9664		9.9993
$b'\sqrt{(1-x^2)} = r \sin v$		9.3390		9.1387		9.9515		9.9874
$x - e = r \cos v$	+0.7439057	9.8715	—1.2205517	0.0865*u*	—0.6089396	9.7815*u*	—0.2862905	9.1568*u*
$\begin{smallmatrix}\sin\\ \cos\end{smallmatrix}$ v or $360° - v$		9.9820		9.9972*u*		9.9182		9.9819
$\tan v$ or $360° - v$	16° 21′ 14″.46	9.4675	186° 26′ 0″.36	9.0521*u*	124° 3′ 39″.60	0.1700*u*	253° 34′ 51″.34	0.5306*u*
r		9.8894		0.0892		0.0363		0.0055
		0.2671		0.4669		0.1140		0.3832
E	12° 57′ 50″.93		188° 7′ 52″.29		112° 13′ 50″.04		266° 48′ 28″.10	
By the usual method E	$50''.93$		$52''.29$		$50''.08$		$28''.12$	
v	14.16		0.36		39.64		51.36	
r		1364		9818		0096		2234

Note. — In some parts of these calculations, logarithms of seven decimal places were used. But the last figures have been omitted, for convenience in printing.

The first part of this calculation is entirely unnecessary, as soon as one becomes familiar with the use of the table; the second part, as can be seen, is only required where the greatest accuracy is necessary, so we have only to take P from the table as it is equal to M (expressed in units of the radius) $-\frac{\pi}{2}$, find in the table the two including P, interpolate x or $\sqrt{(1-x^2)}$, and finish the third part of the above calculation.

OBSERVATIONS OF THE TWENTY-FIRST ASTEROID.

[Communicated by Professor C. Rümker.]

Date.	Hamburg M. T.	㉑ α	Log. Factor of Parallax.	㉑ δ	Log. Factor of Parallax.	No. of Comp.		Apparent Places of Comparison-Stars R.A.	Apparent Places of Comparison-Stars Dec.
	h m s	° ′ ″		° ′ ″				h. m. s.	° ′ ″
1852, Nov. 28	7 28 55.4	38 20 14.3	9.5768*n*	+12 24 30.0	9.8360	5	*a*		
29	6 23 26.3	38 11 4.5	9.6896*n*	12 23 5 ::	9.8513	3	*c*		
Dec. 3	7 8 44.6	37 34 55.4	9.5701*n*	12 20 5.6	9.8345	8	*c*		
11	6 39 15.2	36 44 55.2	9.5568*n*	12 20 57.0	9.8347	5	*b*, *c*		
12	6 50 50.6	36 40 38.6	9.5129*n*	12 21 33.3	9.8315	7	*b*		
17	7 19 51.6	36 26 44.2	9.3187*n*	12 27 16.7	9.8213	13	*b*		
1853, Jan. 2	9 32 53.5	36 57 51.3	9.1679	13 7 52.0	9.8213	7	*d*	2 28 0.14	+13 6 35.4
9	6 6 12.5	37 42 9.3	9.2520*n*	13 34 5.0	9.8120	15		2 29 47.53	13 30 39.1
11	6 59 30.9	38 0 16.8	8.3207*n*	+13 42 39.2	9.8066	11		{ 2 31 49.35 { 2 34 7.40	13 32 0.9 +13 58 12.9

The three first compared stars have been reobserved, whence the following apparent places are derived.

a	1852, Dec. 11	App. R.A. 2h 31m 33s.311	Dec. +12° 11′ 39″.3	1 Meridian-Circle.
b	16	2 27 21.680	12 29 47.3	3 " "
c	11	2 29 6.6	+12 15 42.7	

January 2, the planet preceded a fixed star of 11.12 magnitude, in the same parallel of declination, by 2s.2 in time.

NOTICE.

I am requested to state that the heirs of Professor Schumacher have decided to reduce the price of the few remaining copies of the first thirty-one volumes of the *Astronomische Nachrichten* to five marks the volume, or four marks where six or more volumes are taken at once. Of the first eleven volumes, however, many are exhausted, and of the others there are but few remaining.

It will give me pleasure to aid any American astronomers or scientific institutions, who may desire to avail themselves of this opportunity of securing copies of this invaluable work.

G.

1853, *January* 17.

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OBSERVATIONS OF THE SECOND COMET OF 1852, IRENE, AND MELPOMENE,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury.]

[Corrected for refraction.]

SECOND COMET OF 1852. (Westphal.)

Date.	M. T. Washington.	No. of Comp.	Comparison Star.	☄ — *		☄'s apparent		A.
				Δα	Δδ	α	δ	
1852.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
Sept. 5	9 59 28.8	8	Argel. Z. 2443	—1 17.44	+13 16.11	2 1 5.16	+49 7 5.95	10
		8	" 2462	—2 4.55	+ 2 7.36	2 1 5.47	49 7 9.78	
7	9 31 45.7	10	Groomb. 466	—0 7.00	— 3 42.14	2 3 26.27	52 17 59.48	10
8	9 40 46.1	12	Argel. Z. 2511	+0 1.80	+ 4 57.00	2 4 55.96	53 55 6.89	10
(1) 13	11 22 23.5	6	" 2680	—1 4.01	+ 0 14.23	2 12 17.79	62 0 54.80	10
16	10 36 0.0	6	B. A. C. 741	+0 26.50	— 8 27.55	2 17 26.99	66 35 28.73	10
17	11 3 13.0	4	*b*	+0 43.57	+ 1 42.33	2 19	68 6	10
Oct. 1	8 24 14.5	4	*c*	—2 55.81	— 6 53.19	4 0	85 58	9
(2) (*m*) 2	7 41 19.1	9	*d*	+0 45.62	+14 12.23	4 33	86 40	9
(*m*) 5	8 54 18.8	7	*e*	+4 42.32	+ 8 5.38	9 8	88 2	10
7	8 48 57.2	8	*f*	+4 38.4	— 7 43.13	11 47	86 54	10
(*m*) 8	7 49 53.4	10	*g*	+0 29.02	+ 2 49.50	12 19 31.81	86 11 15.91	10
(*m*) 10	7 25 20	2	*h*	+2 7.24	+ 1 43.30	12 54	84 37	8
(*m*) 11	7 38 12	10	*i*	+7 38.60	+ 4 41.70	13 7	83 50	10
15	7 47 24.6	10	*k*	+2 18.85	— 1 14.23	13 31	80 40	9
16	7 15 12.5	10	*l*	—2 5.06	+ 3 18.12	13 34	80 8	9
19	7 35 48.4	4	*m*	+1 3.37	—11 39.04	13 43	78 14	10
20	7 7 38.6	6	*n*	—1 25.33	—16 21.27	13 45	77 39	10
21	7 27 24.8	9	*o*	—6 43.86	+ 1 12.65	13 47	77 3	10
23	7 1 4.3	8	*p*	+1 51.12	+ 0 7.41	13 50	75 57	10
24	7 40 39.5	7	*q*	—3 46.82	— 3 34.82	13 51	75 25	10
25	7 15 53.3	7	*r*	+3 37.16	— 1 28.29	13 52	74 55	10
Dec. 1	8 5 59.5	2	*s*	—0 42.58	+ 0 55.53	14 0	66 20	10
8	8 59 1.8	3	*t*	+1 0.05	+ 4 29.61	13 54	66 22	8
13	7 23 19.8	2	*u*	+0 17.22	+ 2 32.98	13 47	+66 46	9

(1) Star of comparison doubtful.

(2) The comparisons marked (*m*) were made from the distance and angle of position. Where the seconds are omitted, the places are only approximate.

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Argel. Z. 2413	8.9	2 2 12.32	+48 53 11.90	Argelander's Zones, 1851.
" 2462	8.9	2 2 59.67	49 4 27.61	"
Groomb. 466	6.7	2 3 32.53	52 21 7.23	Groomb., Argel., and Radcliffe Obs.
Argel. Z. 2511	7.8	2 4 43.22	53 19 35.86	Argelander's Zones.
B. A. C. 741	4.5	2 16 46.63	66 43 24.94	British Association Catalogue.
b	8.9	2 18	61 6	
c (double)	10.12	4 3	86 5	
d	9.10	4 32	86 26	
e	9	9 3	87 54	
f	8.9	11 43	87 2	
g	9	12 18 52.82	86 9 18.49	Washington Meridian-Circle.
h	9	12 52	84 35	
i	8	12 59	83 45	
k	9	13 29	80 50	
l	8	13 36	80 5	
m	9	13 42	78 25	
n	9.10	13 47	77 55	
o	8.9	13 54	77 2	
p	9.10	13 48	75 57	
q	9	13 55	75 28	
r	9	13 49	74 56	
s	9	14 1	66 19	
t (double)	(9.10.10)	13 53	66 22	
u	9.10	13 47	66 44	
Argel. Z. 2680	9	2 13 9.30	+62 0 8.64	Argelander's Zones, 1851.

IRENE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑭ — * Δα	⑭ — * Δδ	⑭'s apparent α	⑭'s apparent δ	A.
1852.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
Aug. 31	10 5 24.0	2	Lalande 45804	+3 31.41	— 7 50.79	23 19 40.20	—18 43 41.97	10
Sept. 1	10 35 47.4	10	" 45804	+2 28.93	—14 16.08	23 18 47.74	18 50 7.27	10
	10 44 17.5	7	" 45838	+1 19.41	+ 4 7.14	23 18 47.90	18 50 7.20	
2	10 28 24.2	4	" 45838	+0 28.50	— 1 54.08	23 17 56.97	18 56 8.43	10
5	9 7 29.5	6	" 45704	+2 11.85	+ 7 20.27	23 15 23.47	19 13 32.54	10
7	8 42 16.3	10	" 45704	+0 27.60	— 3 53.85	23 13 39.17	19 24 46.70	10
18	10 3 23.2	2	*b*	+1 36.18	— 0 18.08	23 4 7.44	20 15 52.79	10
22	9 5 39.4	6	*b*	—1 35.29	—13 22.90	23 0 55.97	20 28 57.94	10
28	9 6 13.0	4	2	+2 28.54	+16 51.68	22 56 29.12	20 43 1.68	10
29	8 48 17.1	5	2	+1 47.81	+15 11.90	22 55 48.41	20 41 40.41	10
30	8 23 58.1	5	2	+1 8.60	+13 42.81	22 55 9.16	20 46 10.74	9
Oct. 2	9 40 33.3	3	2	—0 10.40	+11 14.14	22 53 50.18	20 48 39.61	9
7	10 56 28.0	6	Lalande 44877	+1 12.13	+12 12.05	22 50 55.06	20 51 28.35	10
8	10 2 11.0	10	" 44877	+0 42.28	+12 11.76	22 50 25.21	20 51 28.74	10
11	9 11 9.3	6	" 44877	—0 40.81	+13 26.67	22 49 2.10	20 50 14.10	10
15	9 18 23.0	6	" 44877	—2 16.12	+17 30.08	22 47 26.75	20 46 13.11	9
	9 21 0.1	5	" 44823	—0 9.16	+ 9 13.81	22 47 26.71	20 46 13.51	9
16	10 15 48.1	3	" 44823	—0 30.13	+10 42.55	22 47 5.73	—20 44 45.03	9

Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.	No. of Comp.
		h. m s	° ′ ″		
Lalande 45804	8	23 16 0.11	—18 36 15.71	Lalande's Catalogue.	
" 45838	9	23 17 19.76	18 55 8.93	"	
" 45701	8	23 13 2.78	19 21 47.01	"	
" 45473	9	23 6 36.30	19 41 16.31	Mean of Lalande and Argelander.	
b	9.10	23 2 22.36	20 16 27.37	Washington Equatorial, from Lal. 45473.	4
Lalande 45049	6	22 51 13.16	21 40 5.80	Mean of Lalande and Argelander.	
(2)	9.10	22 53 51.66	21 0 44.44	Washington Equatorial, from Lal. 45049.	10
Lalande 44877	7.8	22 49 31.05	21 4 30.16	Lalande's Catalogue.	
" 44823	7	22 47 27.02	—20 56 16.09	"	

MELPOMENE.

	Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑱ — *		⑱'s apparent		A.
					Δα	Δδ	α	δ	
		h. m. s			m. s.	′ ″	h. m. s.	° ′ ″	
	1852, Oct. 8	6 49 52.8	10	Lalande 34401	+3 18.00	— 3 9.94	18 31 10.30	—18 57 7.18	10
		6 52 22.8	9	*f*	+1 8.17	— 2 56.18			10
	10	6 36 58.7	6	*f*	+1 21.57	—10 26.03	18 31 23.79	19 4 37.49	8
			6	*g*	—1 1.20	—10 28.80			8
	11	6 36 56.5	20	*g*	+0 37.55	—14 6.08	18 36 2.54	19 8 14.17	10
	15	7 5 21.1	10	Madras 1304	—1 25.27	— 4 6.25	18 42 51.41	19 21 34.26	9
	16	6 40 7.3	10	"	+0 16.90	— 7 2.10	18 44 33.57	19 21 30.00	9
	17	6 39 47.8	1	"	+2 2.01	— 9 53.77	18 46 19.66	19 27 21.68	7
	19	7 8 33.4	3	Lalande 35197	—4 28.99	— 5 32.38	18 49 53.26	19 32 39.93	8
	20	6 30 17.8	8	"	—2 13.57	— 7 56.95	18 51 38.67	19 35 5.32	10
	21	6 26 13.7	14	"	—0 54.92	—10 33.17	18 53 27.30	19 37 41.69	10
	23	6 22 15.5	10	"	+2 45.97	—11 31.12	18 57 8.11	19 41 39.67	10
	24	7 0 14.3	12	B. A. C. 6536	—0 32.44	—12 13.37	18 59 3.60	19 43 42.83	10
	25	6 33 56.3	10	"	+1 18.13	—14 27.62	19 0 54.18	19 45 27.13	10
	Nov. 7	7 20 36.2	6	Lalande 36857	+3 33.35	—14 11.13	19 26 36.72	19 55 40.69	8
	9	6 32 17.4	4	*h*	+1 1.30	— 1 17.99	19 30 42.14	19 54 46.42	10
(¹)	19	6 32 12.9	1	Lalande 38164	—1 29.20	—12 50.15	19 51 57.30	19 42 52.10	6
		7 21 2.1	4	"	—1 24.31	—12 43.14	19 52 2.15	19 42 15.10	6
	21	6 38 25.0	4	"	+2 53.66	— 8 34.81	19 56 20.14	19 38 36.81	10
			4	B. A. C. 6923	—5 31.43	+ 9 48.23	19 56 20.12	19 38 45.28	10
	27	6 1 42.8	16	" 6981	—1 17.85	+12 12.27	20 9 31.34	19 22 17.94	10
	28	5 47 29.7	8	" 6981	+0 55.10	+15 21.66	20 11 47.58	19 19 5.55	10
(²)	29	5 36 30.6	3	" 6981	+3 12.19	+18 57.59	20 14 4.37	19 15 32.64	10
	30	6 4 15.9	5	" 7053	—5 4.74	— 7 44.98	20 16 19.53	19 11 56.87	10
(³)			5	" 7054	—5 6.53	— 7 57.99	20 16 19.01	19 12 2.39	10
	Dec. 1	6 1 5.6	10	" 7053	—2 49.32	— 3 59.76	20 18 34.97	19 8 11.67	10
			10	" 7054	—2 51.27	— 4 13.00	20 18 34.31	19 8 17.43	10
	5	7 4 40.5	4	" 7131	—3 51.11	—12 15.86	20 27 47.11	18 51 34.83	10
	8	6 2 8.5	5	" 7131	+2 56.34	+ 1 40.00	20 34 34.55	18 37 38.99	10
		6 23 1.2	14	" 7159	+0 21.08	+ 0 21.35	20 34 36.55	18 37 40.07	10
	12	6 29 57.4	4	" 7209	+2 55.25	+17 43.73	20 43 52.68	18 16 52.33	8
		6 40 26.1	2	" 7219	—2 33.64	+11 53.79	20 43 53.30	18 16 50.32	8
	13	5 58 25.2	14	" 7219	—0 17.42	+17 7.79	20 46 9.51	18 12 36.35	9
	17	6 15 25.5	5	" 7283	+2 58.74	+18 31.84	20 55 31.43	17 47 10.51	10
	18	6 0 11.7	12	" 7322	+0 12.60	+ 7 30.08	20 57 51.12	17 41 27.42	10
(⁴)	29	6 25 59.6	7	*k*	+1 5.50	+ 7 11.30	21 23 54.50	16 22 56.34	8
	1853, Jan. 2	6 13 13.3	12	Rümker 9319	+0 1.86	—19 34.86	21 33 24.60	15 50 13.85	10
	4	6 16 37.2	8	B. A. C. 7556	+2 14.71	— 7 42.49	21 38 11.61	15 33 10.18	10
	7	6 12 55.0	14	Weisse XXI. 1071	+0 1.62	—13 37.57	21 45 22.90	15 6 33.58	10
(⁵)	16	6 18 59.8	8	B. A. C. 7771	—1 55.01	— 6 20.05	22 6 58.35	13 40 13.40	7
	17	6 19 3.9	14	"	+0 28.93	+ 3 50.54	22 9 22.31	—13 30 2.84	10

(¹) Night very unfavorable.

(²) Observed among clouds.

(³) The determination by 7053 to be preferred.

(⁴) *k* is determined by only three comparisons.

(⁵) High wind and very cold. Stars blurred and restless.

Adopted Mean Places, 1850.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.	No. of Comp
		h. m. s.	° ′ ″		
Lalande 31401	7.8	18 27 43.98	—18 51 3.78	Lalande's Catalogue.	10
f	8.9	18 29 53.97	18 51 18.93	Washington Equatorial.	6
g	9	18 35 16.73	18 54 16.66	" "	
Madras 1304	9	18 44 8.42	19 17 40.06	Madras Catalogue.	
Lalande 35197	6.7	18 51 14.00	19 27 20.55	Lalande's Catalogue.	
B. A. C. 6536	6.7	18 59 27.87	19 31 12.6	B. Association Catalogue.	
Lalande 36857	8	19 22 55.28	19 41 46.45	Lalande's Catalogue.	
h	9	19 26 32.74	19 53 46.16	Washington Equatorial.	5
Lalande 38161	7.8	19 53 18.45	19 30 24.51	Lalande's Catalogue.	
B. A. C. 6923	7	20 1 43.49	19 48 57.04	B. A. C. and Madras.	
" 6981	5	20 10 41.17	19 34 55.6	B. Association Catalogue.	
" 7053	7	20 21 16.23	19 4 30.1	B. A. C. and Rümker.	
" 7054	6	20 21 17.58	19 4 31.62	" "	
" 7131	5	20 31 30.28	18 39 47.84	Rümker (8496).	
" 7159	7	20 34 7.53	18 38 30.7	B. Association Catalogue.	
" 7209	5.6	20 40 49.52	18 35 6.3	" "	
" 7249	6	20 46 19.04	18 29 15.16	B. A. C. and Rümker.	
" 7283	6	20 52 24.82	18 6 41.30	" "	
" 7322	5	20 57 30.66	17 49 30.24	" "	
" 7485	7	21 25 22.71	16 51 32.00	B. Association Catalogue.	
k	9	21 22 41.20	16 30 46.85	Washington Equatorial.	3
Rümker 9349	7	21 33 15.26	15 31 16.70	Rümker's Catalogue.	
B. A. C. 7556	6	21 35 49.20	15 26 5.96	Rümker and B. A. C.	
Weisse XXI. 1071	8	21 45 13.57	14 53 35.16	Weisse's Catalogue.	
B. A. C. 7771	6	22 8 45.73	—13 31 35.10	B. Association Catalogue.	

FROM A LETTER OF DR. BRÜNNOW TO THE EDITOR.

Berlin, 1853, *January* 9.

As my ephemeris of *Flora* was in error by ten seconds of time during the past year, I suspected some oversight in the numerical determination of the perturbations, and have repeated them from 1848, January 1, onward, according to my method, — taking into account only the influence of *Jupiter* and *Saturn*, as the influence of the other planets was found unimportant in the former computation. My suspicions were fully confirmed by the detection of an error in the perturbations of the mean motion.

The most perfect representation of the oppositions of 1848, 1849, 1850, and 1852, according to the method of least squares, to be obtained by using the newly determined values of the perturbations of the true anomaly, radius-vector, and latitude from the orbit, gives the following elements for *Flora*: —

1848, January 1.0, M. T. Berlin.

M	35° 48′ 24″.33	
π	33 0 23.17	Mean Equinox,
☊	110 18 3.79	1848, January 1.0.
i	5 53 6.23	
φ	9 0 22.21	
μ	1086.135551	
Log a	0.3427481	

These elements agree almost precisely with those which I deduced from the first appearance in 1847–48 (*Astr. Nachr.*, No. 645), and which I give you for the sake of comparison.

M	35° 48′ 7″.05
π	33 0 40.79
☊	110 18 12.02
i	5 53 4.80
φ	9 0 25.59
μ	1086.13515

The perturbations for *Victoria* I have also recomputed by the new method, and corrected the elements by means of observations during the opposition of 1852. I find

1851, January 0.

M	65° 46′ 35″.62
π	301 52 31.40
☊	235 26 54.36
i	8 23 6.80
φ	12 36 9.82
μ	994.47733
Log a	0.3682745

The ephemeris for 1853 has been computed with these elements, after the application of the computed perturbations.

FROM LETTERS OF PROFESSOR CHARLES RÜMKER TO THE EDITOR.

Hamburg, 1853, *January* 25.

TWENTY-SECOND ASTEROID.

Date.	Hamburg M. T.	㉒ App. α	Log. Factor of Parallax.	㉒ App. δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars.	
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
1852, Dec. 11	7 55 33.0	72 12 57.2	9.7226 *n*	+26 14 26.9	9.7500	9	4 52 13.169	+26 18 42.2
12	7 59 23.6	71 57 7.8	9.7096 *n*	26 17 57.8	9.7422	7	4 52 13.169	26 18 42.2
17	8 51 38.9	70 39 35.0	9.5274 *n*	26 34 34.1	9.6900	8	4 43 52.912	26 31 37.7
18	8 39 30.6	70 21 41.7	9.5582 *n*	26 37 39.8	9.6953	10	4 39 14.783	26 41 53.7
1853, Jan. 4	8 32 22.1	67 0 12.8	9.2264 *n*	27 22 21.4	9.6583	4	4 34 26.95	26 24 56.7
6	8 21 12.3	66 43 39.4	8.8698 *n*	27 27 19.5	9.6150	2	4 25 36.80	27 13 16.8
9	9 27 53.6	66 21 53.9	8.7588	27 33 42.3	9.6427	5	4 25 36.76 4 28 1.72	27 13 17.0 27 13 14.7
11	9 0 17.6	66 9 56.7	7.2563	+27 37 38.6	9.6408	2	4 21 11.12 4 28 1.79	27 48 10.0 +27 37 14.6

TWENTY-THIRD ASTEROID.

Date.	Hamburg M. T.	㉓ App. α	Log. Factor of Parallax.	㉓ App. δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars.	
	h. m. s.	° ′ ″		° ′ ″			h. m s	° ′ ″
1852, Dec. 18	9 54 9.2	47 31 46.5	8.9716	+17 0 15.9	9.7745	9	3 8 54.61	+17 1 43.0
1853, Jan. 2	8 35 18.0	46 18 53.1	8.7111	18 5 47.1	9.7622	5	3 5 46.04 3 5 56.42	17 45 42.3 17 47 29.5
3	6 10 27.0	46 18 27.7	9.5026 *n*	18 10 24.2	9.7798	9	3 2 23.26	18 10 56.2
4	7 4 12.7	46 18 20.0	9.2380 *n*	18 15 39.0	9.7653	9	3 2 23.26	18 10 56.2
5	6 29 59.0	48 18 43.9	9.4004 *n*	18 20 47.5	9.7707	7	3 4 11.98 3 5 33.48	18 23 22.1 18 25 7.8
6	7 18 12.4	46 19 48.5	9.0398 *n*	18 26 18.1	9.7608	12	3 5 33.47	18 25 7.7
9	7 35 6.0	46 26 17.8	8.5779 *n*	18 42 48.8	9.7553	8	3 5 45.38	+18 42 48.6
11	8 3 55.9	46 33 16.5	8.7938	+18 54 11.1	9.7556	7	δ *Arietis.*	

Hamburg, 1853, *February* 4.

I TAKE this opportunity of sending you some observations of *Eunomia* and *Neptune* made by my son, with the exception of two with the Meridian-Circle.

FIFTEENTH ASTEROID.

Date.	Hamburg M. T.	⑮ App. α	Log. Factor of Parallax.	⑮ App. δ	Log. Factor of Parallax.	Instrument.
	h. m. s.	° ′ ″		° ′ ″		
1852, Dec. 11	11 22 52.7	71 30 33.2		+31 56 47.1	9.5010	Meridian-Circle.
12	11 17 52.6	71 14 28.3		31 48 38.9	9.5030	"
22	8 28 30.2	68 52 58.1	9.5542 *n*	33 21 50.1	9.4977	Equatorial.
23	5 55 7.2	68 42 5.4	9.8188 *n*	33 13 43.7	9.7376	"
23	10 24 20.5	68 39 48.6		33 12 1.5	9.5379	Meridian-Circle.
1853, Jan. 2	9 38 45.9	67 5 39.0		31 40 20.2	9.5697	"
4	9 30 4.2	66 53 6.1		31 22 23.4	9.5739	"
6	9 21 30.1	66 42 34.4		31 4 41.4	9.5794	"
9	9 8 41.5	66 28 3.2		+30 37 18.8	9.5875	"

NEPTUNE.

1852.	Hamburg M. T.	♆ App. α	♆ App. δ
	h m. s	° ′ ″	° ′ ″
Dec. 12	5 17 7.2	310 48 16.9	−9 5 32.8
18	4 53 51.3	310 53 11.8	−9 3 32.5

Re-observed Mean Places for January 0, 1853, *of Comparison-Stars.*

TWENTY-FIRST ASTEROID.

✳ Mean α 1853. h. m. s.	✳ Mean δ 1853. ° ′ ″	No. of Obs.
2 27 22.019	+12 29 47.9	3
2 29 6.909	12 15 45.0	1
2 31 33.618	+12 11 42.0	1

TWENTY-SECOND ASTEROID.

✳ Mean α 1853. h. m. s.	✳ Mean δ 1853. ° ′ ″	No. of Obs.
4 34 26.772	+27 24 57.9	1
4 52 13.157	26 18 42.4	1
4 52 38.115	+26 26 56.9	1

TWENTY-THIRD ASTEROID.

✳ Mean α 1853. h m. s	✳ Mean δ 1853. ° ′ ″	No. of Obs.
3 0 1.792	+18 13 37.3	2
3 2 23.591	18 10 57.2	1
3 4 12.534	18 23 12.7	2
3 6 9.833	18 11 54.8	2
3 6 32.262	18 8	2
3 11 41.029	+16 57 41.1	2

C. RÜMKER.

ON THE OBSERVATION AND COMPUTATION OF THE ASTEROIDS AND THEIR ORBITS.

By the EDITOR.

The rapid increase in the number of known asteroids renders the observation and computation of this one group so onerous as to occasion a very considerable diminution of the energies left free for investigation of questions of general astronomical interest and importance. The recording books of observers, the tables of computers, and the pages of astronomical periodicals are crowded with observations, elements, and ephemerides of these minute bodies, to the comparative exclusion, for some years past, of the investigations in physical and stellar astronomy, the expectation of which had been authorized by the late rapid increase of the number of astronomical inquirers and instruments.

Should new members of this group be detected for the next two or three years at the extraordinary rate with which the restless energy of Hind and Gasparis has added to the catalogue during the last two years, the most careful organization and division of labor will be requisite to avoid the threatened consumption of the astronomical energies of two continents in the effort to follow each individual of this great cohort, in their monotonous, though intricate march.

Influenced by these convictions, I ventured when in Europe, some eighteen months since, to suggest to several of the astronomers, whose labors in this field entitle their wishes as well as opinions to the greatest deference, the expediency of such a division of labor in the observation and computation of the asteroids as might render it possible to fulfil the duties imposed upon astronomers by the detection of so many members of this group, with the smallest possible total expenditure of astronomical labor.

The question, however, seemed at that time to present itself to some in a different light, and it appeared therefore advisable to postpone for a while any public proposition. But astronomers on each side of the Atlantic have recently advised a renewal of the suggestion, and as the urgency of the matter is daily increasing, prompt action is desirable. Twenty-three of these bodies are now known to us, and there is every reason to apprehend, that, before the present year shall have elapsed, this great number may have become greater still.

On the other hand, we may assume that, after the year of discovery, only observations of the opposition will be used, and the recently published elegant formulas of Encke, Hansen, and Brünnow render the computation of the special perturbations of the larger planets a much shorter and less wearisome process than before. Should, now, observers apportion among themselves the known asteroids, each selecting a certain number and engaging to observe these for a few weeks at their opposition, — and should computing astronomers in like manner select certain asteroids for their especial charge, assuming the responsibility of regularly providing ephemerides, and of correcting the elements after each opposition, such division of labor could not but be prolific of advantage for the progress of astronomy. The history of the charts of the Berlin Academy, and the priceless computations of Encke concerning the comet which bears his name, afford appropriate illustrations of the effect of such organization or individual superintendence.

Should these suggestions find the favor with astronomers which I venture to anticipate, the desired end will probably be attained by public announcement, on the part of responsible astronomers, of readiness to assume the labor of permanently observing or computing the path of particular asteroids.

In behalf of the Washington Observatory, I am authorized by its Superintendent to announce that he will cheerfully assume the responsibility of furnishing observations of a suitable number of asteroids at their oppositions, and the Superintendent of the American Ephemeris also authorizes me to state, that he is ready to provide for the computation of such a number as may be deemed a proper proportion for American computers.

1853, *February* 14.

FROM A LETTER OF W. C. BOND TO THE EDITOR.

Harvard College Observatory, 1853, *March* 9.

Last evening a Comet was discovered at this Observatory, by assistant Charles W. Tuttle. The places obtained were as follows: —

	Cambridge M. S. T.	☄ — *		
	h. m. s.	$\Delta\alpha$	$\Delta\delta$	
March 8	8 28 4.5	$+15^{s}.18$	$-0''.76$	7 Obs. in R.A. and 6 Obs. in Dec.

Approximate Place of Star.

Star 10.11 Magnitude R.A. $4^{h.}\ 46^{m.}\ 37^{s.}$ Dec. South 10° 59′.

At $9^{h.}\ 23^{m.}\ 53^{s}.5$, Star of Comparison, Weisse, Hora IV. No. 1031.

☄ — *	
$\Delta\alpha$	$\Delta\delta$
$-5^{s}.42$	$-1'\ 43''.9$

☄'s App. R.A. $4^{h.}\ 46^{m.}\ 45^{s}.54$ Dec. South 10° 55′ 11″.0 6 Obs. in R.A. and 4 Obs. in Dec.

W. C. BOND.

NEW WORKS.

1. *American Ephemeris and Nautical Almanac for the Year* 1855. — After careful and unremitting preparatory labors, for a period of three years, the first volume of this work has been given to the public; and it may not be an exaggerated estimate of its value, to believe that its influence upon the development of astronomy in the United States will be very important. Under the able and enlightened superintendence of Lieutenant C. H. Davis, the labors of Professor Peirce, assisted by a corps of accomplished computers, have introduced refinements into almost every part of the work, and entitled this pioneer of American science to take place and rank with its renowned brethren of Berlin, London, and Paris, and to prepare for a noble emulation.

The Ephemeris consists of two distinct parts, one adapted for navigators who are accustomed to refer their longitude to the meridian of Greenwich; the other for the use of astronomers, — computed for the meridian of the Naval Observatory at Washington.

In the former, the place of the moon is given for every hour throughout the year, and the semidiameter for each noon and midnight, — the apparent places and the rectangular equatorial coördinates of the sun, — as also an ephemeris of the four planets, *Venus*, *Mars*, *Jupiter*, and *Saturn*, for every noon. These, together with the customary table of lunar distances, make up the purely nautical portion.

In the part designed for the use of astronomers, and referred to the meridian of Washington, the most striking features are the introduction of sidereal noon as an argument for the ephemeris of the superior planets, and the fixed stars; — the columns added to the planetary ephemerides to facilitate interpolation; — the fulness with which the solar coördinates are given for every noon and midnight, and for both the apparent equinox of date, and for the mean equinox and equator of January 0.0; — the heliocentric coördinates of the planets for intervals of ten days, together with the inclinations, nodes, and masses, given to aid in the computation of perturbations, the arguments of these being the number of the day counted from the commencement of the Julian period; — the table of elements for facilitating the calculation of occultations computed by Bessel's method as in the Berlin *Jahrbuch*, and extended to include all those stars of the British Association Catalogue, to the 6 magnitude inclusive, which can be occulted by the moon during the year.

Throughout the computations, the values of the precession, the obliquity of the ecliptic, and the equation of the equinoxes, as determined by Struve and Peters, and Struve's value of the constant of aberration, have been used. The mean places of the fixed stars are derived from Airy's Twelve-Year Catalogue, as in the English Almanac prior to the volume for 1855, and the apparent places have been thence deduced by means of tables constructed for the purpose. Following the praiseworthy example of Encke, the moon-culminating stars of the London Almanac have been adopted; but these are arranged in a peculiar method, for economy of space, and security against typographical error.

The ephemeris of the sun is constructed from the tables in the *Effemeride di Milano*, 1833, using the correction for latitude in the geocentric coördinates. That of the moon is computed from new lunar tables constructed and printed for the purpose. The value adopted for the moon's semidiameter is that deduced by Burckhardt from eclipses and occultations, increased by $\frac{1}{500}$. It is a curious fact, that the value given by meridian observations appears to vary with the telescope used, and to be greater than BURCKHARDT's value by an amount varying, according to Professor PEIRCE, from 2″ to 3″.

The ephemerides of the planets exhibit an important increase of precision, improved tables having been constructed for all. Under the skilful and gifted superintendence of Professor JOSEPH WINLOCK, LE VERRIER's theory of *Mercury* has been reduced to the form of tables, which it is to be hoped will soon be given to astronomers. The ephemeris of *Uranus* differs especially from all previous ones, the corrections and perturbations arising from the influence of *Jupiter* and *Saturn* and *Neptune*, as determined by LE VERRIER and PEIRCE, having been applied to the pure elliptic portion of BOUVARD's Tables.

For the apparent elements of *Saturn's* ring, the table refers to the outer ellipse of the outer ring, and factors are appended by which a simple multiplication gives the axes of the five other ellipses.

In the Appendix to the Almanac are a few tables, WALKER's ephemeris of *Neptune* for 1853, and the tables of CHAUVENET for correcting lunar distances with accompanying directions for use. (See *Astr. Journal*, Nos. 27 and 28.)

The "American Ephemeris and Nautical Almanac" is elegantly printed, on excellent paper, in a type agreeable to the eye and contrasting most favorably with the distorted characters recently in fashion for astronomical and mathematical works. Lieutenant DAVIS may claim the thanks of astronomers.

2. *Tables of the Moon, constructed from* PLANA's *Theory, with* AIRY's *and* LONGSTRETH's *Corrections,* HANSEN's *Inequalities of Long Period, arising from the Action of Venus, and* HANSEN's *Values of the Secular Variations of the Mean Motion and of the Motion of the Perigee. Arranged in a Form designed by Professor* BENJAMIN PEIRCE, *Consulting Astronomer, for the Use of the Nautical Almanac, under the Superintendence of* CHARLES HENRY DAVIS, *Lieutenant U. S. Navy, and published under the Authority of the Hon.* JOHN P. KENNEDY, *Secretary of the Navy.* Washington. Printed for the Use of the Nautical Almanac. 1853. — The aim and character of this work are so completely expressed in its title, that farther description appears unnecessary. The chief distinctive features of its arrangement consist in its adaptation to the computation of a large number of lunar places at once, especially for an ephemeris, — in the elegant formulas for interpolation, — and in the readiness with which the moon's latitude may be obtained.

G.

DEATH OF S. C. WALKER.

SEARS COOK WALKER died in Cincinnati, at the residence of his brother, Hon. TIMOTHY WALKER, on Sunday evening, January 30, in the forty-eighth year of his age, and the science of America weeps for him. He was a leader in the recent advance of astronomy and physics in our country, — with ever youthful enthusiasm and a love for science surpassing every other love. The restless activity of his intellect wore away his frame, as the sharp sword its scabbard. He has striven more gallantly, and has fallen in a nobler warfare, than chieftains whose names dwell on every tongue.

G.

Charleston, S. C., 1853, *February* 9.

CORRIGENDUM.

Page 40, 1853, Jan. 9, col. ㉑ α, *for* 37° 42′ 9″.3, *read* 37° 43′ 29″.9.

THE Editor deeply regrets that the printing of this and the preceding numbers has been delayed during his absence from home.

G.

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THE

ASTRONOMICAL JOURNAL.

No. 55.

VOL. III. CAMBRIDGE, 1853, MARCH 28. NO. 7.

EPHEMERIS OF EGERIA FOR THE OPPOSITION IN 1853.

By PROFESSOR J. S. HUBBARD,
OF THE WASHINGTON OBSERVATORY.

Although, on account of the great southern declination of *Egeria* and its distance, being in aphelion, it is not probable that many observations will be obtained this year, I have prepared the following ephemeris, hoping for at least one or two additional normals, before proceeding to a further correction of the elements. I have computed the perturbations by *Jupiter* and *Saturn* for intervals of forty days, from 1852, December 1, to 1854, January 5, and obtained the following values for the continuation of the table given in No. 49 of this Journal, excepting that the quantity δz here represents the variation of the coördinate z perpendicular to the equator, while there the quantity $\{z\}$ represented the variation of the same coördinate perpendicular to the plane of the orbit.

	δr	δu	δz
1852, Dec. 1	—5654.0	+151″.30	+426.9
1853, Jan. 10	—3509.7	+170.10	+626.3
1853, Feb. 19	— 539.0	+182″.88	+ 917.0
Mar. 31	+ 3198.8	187.49	1308.4
May 10	7566.3	182.09	1800.1
June 19	12366.0	165.37	2381.0
July 29	17367.3	136.58	3031.0
Sept. 7	22330.5	95.56	3724.2
Oct. 17	27024.9	+ 42.60	4431.3
Nov. 26	31237.9	— 21.61	5122.0
1854, Jan. 5	+34779.6	— 96.06	+5767.0

The interpolation of the values of log $(r + \delta r)$ and of $u + \delta u + \lambda$, and the correction of the coördinates, were performed in the same manner as in the preceding memoir. It is probable that this ephemeris will prove sufficiently accurate to guide observers, and enable them to reduce completely such observations as they may succeed in obtaining.

Mean Noon Berlin.	⑬ α	⑬ δ	Log △	Log π	Aberration.
	h. m. s.	° ′ ″			d.
1853, March 27	18 46 19.20	—33 11 48.4	0.41526	0.5178	0.01499
31	50 38.69	32 44.8	.40666	.5264	.01470
April 4	54 41.31	33 54 33.2	.39790	.5351	.01440
8	18 58 25.69	34 17 20.3	.38901	.5440	.01411
12	19 1 50.56	34 41 11.9	.38001	.5530	.01382
16	4 54.66	35 6 13.0	.37094	.5621	.01354
20	7 36.76	32 27.4	.36183	.5712	.01325
24	9 55.59	35 59 58.2	.35272	.5803	.01298
28	11 49.71	36 28 47.2	.34366	.5894	.01271
May 2	13 17.61	36 58 53.4	.33469	.5983	.01245
6	14 17.73	37 30 13.9	.32586	.6072	.01220
10	14 48.70	38 2 42.3	.31726	.6158	.01196
14	14 49.40	38 36 9.0	.30893	.6241	.01173
18	14 19.00	39 10 21.4	.30097	.6321	.01152
22	13 16.91	39 45 3.4	.29343	.6396	.01132
26	11 42.73	40 19 55.8	.28639	.6466	.01114
30	9 36.38	40 54 35.5	.27994	.6531	.01098
June 3	6 58.36	41 28 36.0	.27414	.6589	.01083
7	3 49.93	42 1 27.4	.26909	.6639	.01071
11	19 0 13.31	42 32 39.1	.26485	.6682	.01060
15	18 56 11.61	43 1 40.1	.26148	.6716	.01052
19	18 51 48.65	—43 28 2.2	0.25904	0.6740	0.01046

Mean Noon Berlin.	⑬ α	⑬ δ	Log $\triangle$	Log π	Aberration.
	h. m. s.	° ′ ″			d
1853, June 23	18 47 8.79	—43 51 19.7	0.25755	0.6755	0.01042
27	42 16.96	44 11 11.0	.25706	.6760	.01041
July 1	37 18.60	27 19.3	.25755	.6755	.01042
5	32 19.70	39 34.3	.25903	.6740	.01046
9	27 26.39	47 52.2	.26148	.6716	.01052
13	22 44.71	52 19.7	.26486	.6682	.01060
17	18 20.04	53 6.2	.26911	.6639	.01071
21	14 16.96	50 28.6	.27417	.6589	.01083
25	10 39.25	44 46.2	.27997	.6531	.01098
29	7 29.95	36 20.0	.28644	.6466	.01114
August 2	4 51.56	25 32.7	.29350	.6395	.01132
6	2 45.84	44 12 47.3	.30108	.6320	.01152
10	1 13.82	43 58 26.5	.30910	.6239	.01174
14	18 0 15.72	42 50.0	.31747	.6156	.01197
18	17 59 51.11	26 17.3	.32612	.6069	.01221
22	17 59 59.13	43 9 2.7	.33500	.5980	.01246
26	18 0 38.79	42 51 18.1	.34403	.5890	.01272
30	1 48.91	33 13.2	.35317	.5799	.01299
Sept. 3	3 28.33	42 14 55.8	.36237	.5707	.01327
7	5 35.65	41 56 32.2	.37158	.5615	.01356
11	8 9.32	38 6.0	.38076	.5523	.01384
15	11 7.64	19 39.7	.38987	.5432	.01414
19	14 28.95	41 1 13.0	.39888	.5342	.01413
23	18 18 11.73	—40 42 45.2	0.40776	0.5253	0.01473

SOME NEW FORMULAS OF SPHERICAL TRIGONOMETRY.

By WILLIAM CHAUVENET,

PROFESSOR OF MATHEMATICS IN THE UNITED STATES NAVAL ACADEMY.

1. If we denote by

A, B, C, the angles of a triangle, plane or spherical;

a, b, c, the sides opposite these angles respectively;

r, ρ, the radii of the circumscribed and inscribed circles;

δ, the distance between the centers of these circles;

then we have in the plane triangle the relation

$$\sin A + \sin B + \sin C = 4 \cos \tfrac{1}{2} A \cos \tfrac{1}{2} B \cos \tfrac{1}{2} C \qquad (1.)$$

and in the spherical triangle the corresponding relation

$$\sin A + \sin B + \sin C = 4 \cos \tfrac{1}{2} A \cos \tfrac{1}{2} B \cos \tfrac{1}{2} C \,.\, \frac{\cos \delta}{\cos r \cos \rho} \qquad (\text{I.})$$

This analogy, pointed out by D'ARREST (*Astronomische Nachrichten*, No. 833), is but one of a great number that may be traced between the formulas of plane and spherical triangles. I am not aware that any of the following have been given before.

2. If we produce the sides of the triangle, and consider the three other circles which touch two of these sides interiorly and the third side exteriorly; and denote by

ρ', ρ'', ρ''', the radii of the circles touching exteriorly the sides a, b, c, respectively;

δ', δ'', δ''', the distances of the centers of these circles from the center of the circle circumscribed about the primitive triangle;

then we have, in the plane,

$$\left.\begin{aligned} -\sin A + \sin B + \sin C &= 4 \cos \tfrac{1}{2} A \sin \tfrac{1}{2} B \sin \tfrac{1}{2} C \\ \sin A - \sin B + \sin C &= 4 \sin \tfrac{1}{2} A \cos \tfrac{1}{2} B \sin \tfrac{1}{2} C \\ \sin A + \sin B + \sin C &= 4 \sin \tfrac{1}{2} A \sin \tfrac{1}{2} B \cos \tfrac{1}{2} C \end{aligned}\right\} \qquad (2.)$$

and, in the sphere,

$$\left.\begin{aligned} -\sin A + \sin B + \sin C &= 4 \cos \tfrac{1}{2} A \sin \tfrac{1}{2} B \sin \tfrac{1}{2} C \,.\, \frac{\cos \delta'}{\cos r \cos \rho'} \\ \sin A - \sin B + \sin C &= 4 \sin \tfrac{1}{2} A \cos \tfrac{1}{2} B \sin \tfrac{1}{2} C \,.\, \frac{\cos \delta''}{\cos r \cos \rho''} \\ \sin A + \sin B - \sin C &= 4 \sin \tfrac{1}{2} A \sin \tfrac{1}{2} B \cos \tfrac{1}{2} C \,.\, \frac{\cos \delta'''}{\cos r \cos \rho'''} \end{aligned}\right\} \qquad (\text{II.})$$

In the plane,

$$\cot \tfrac{1}{2} A + \cot \tfrac{1}{2} B + \cot \tfrac{1}{2} C = \cot \tfrac{1}{2} A \cot \tfrac{1}{2} B \cot \tfrac{1}{2} C \qquad (3.)$$

and in the sphere,

$$\left.\begin{aligned} \cot \tfrac{1}{2} A + \cot \tfrac{1}{2} B + \cot \tfrac{1}{2} C &= \cot \tfrac{1}{2} A \cot \tfrac{1}{2} B \cot \tfrac{1}{2} C \,.\, \frac{\cos (\rho + \delta) \cos (\rho - \delta)}{\cos^2 r \cos^2 \rho} \\ \cot \tfrac{1}{2} A \,.\, \frac{\cos \delta'}{\cos \rho'} + \cot \tfrac{1}{2} B \,.\, \frac{\cos \delta''}{\cos \rho''} + \cot \tfrac{1}{2} C \,.\, \frac{\cos \delta'''}{\cos \rho'''} &= \cot \tfrac{1}{2} A \cot \tfrac{1}{2} B \cot \tfrac{1}{2} C \,.\, \frac{\cos \delta}{\cos \rho} \end{aligned}\right\} \qquad (\text{III.})$$

either of which is reduced directly to the formula (3) by the usual process of transition from the sphere to the plane.

Also, we have, in the plane,

$$\frac{1}{\rho'} + \frac{1}{\rho''} + \frac{1}{\rho'''} = \frac{1}{\rho} \qquad (4.)$$

and in the sphere,

$$\left.\begin{aligned} \frac{1}{\operatorname{tang}\rho'} + \frac{1}{\operatorname{tang}\rho''} + \frac{1}{\operatorname{tang}\rho'''} &= \frac{1}{\operatorname{tang}\rho}\cdot\frac{\cos(\rho+\delta)\cos(\rho-\delta)}{\cos^2 r\cos^2\rho} \\ \frac{\cos\delta'}{\sin\rho'} + \frac{\cos\delta''}{\sin\rho''} + \frac{\cos\delta'''}{\sin\rho'''} &= \frac{\cos\delta}{\sin\rho} \end{aligned}\right\} \qquad (\text{IV.})$$

In the plane,

$$-\varrho + \varrho' + \varrho'' + \varrho''' = 4r \qquad (5.)$$

and in the sphere,

$$-\operatorname{tang}\varrho + \operatorname{tang}\varrho' + \operatorname{tang}\varrho'' + \operatorname{tang}\varrho''' = \operatorname{tang}\varrho\,(1+\cos a+\cos b+\cos c). \qquad (\text{V.})$$

3. Again, if we denote by
α, β, γ, the perpendiculars from the angles A, B, C, respectively;
α', β', γ', the lines (in the sphere, arcs) joining these angles and the center of the inscribed circle;
then we have the corresponding formulas:

(plane)
$$\frac{1}{\alpha} + \frac{1}{\beta} + \frac{1}{\gamma} = \frac{1}{\rho} \qquad (6.)$$

(sphere)
$$\left.\begin{aligned} \frac{1}{\sin\alpha} + \frac{1}{\sin\beta} + \frac{1}{\sin\gamma} &= \frac{1}{\sin\rho}\cdot\frac{\cos\delta}{\cos r} \\ \frac{\cos\alpha'}{\sin\alpha} + \frac{\cos\beta'}{\sin\beta} + \frac{\cos\gamma'}{\sin\gamma} &= \frac{1}{\sin\rho} \end{aligned}\right\} \qquad (\text{VI.})$$

(plane)
$$\frac{1}{\alpha^2} + \frac{1}{\beta^2} + \frac{1}{\gamma^2} = \tfrac{1}{4}\left\{\frac{1}{\rho^2} + \frac{1}{\rho'^2} + \frac{1}{\rho''^2} + \frac{1}{\rho'''^2}\right\} \qquad (7.)$$

(sphere)
$$\frac{1}{\sin^2\alpha} + \frac{1}{\sin^2\beta} + \frac{1}{\sin^2\gamma} = \tfrac{1}{4}\left\{\frac{1}{\sin^2\rho} + \frac{1}{\sin^2\rho'} + \frac{1}{\sin^2\rho''} + \frac{1}{\sin^2\rho'''}\right\} \qquad (\text{VII.})$$

(plane)
$$\delta^2 + \delta'^2 + \delta''^2 + \delta'''^2 = 12\,r^2 \qquad (8.)$$

(sphere)
$$\left(\frac{\sin\delta}{\cos\rho}\right)^2 + \left(\frac{\sin\delta'}{\cos\rho'}\right)^2 + \left(\frac{\sin\delta''}{\cos\rho''}\right)^2 + \left(\frac{\sin\delta'''}{\cos\rho'''}\right)^2 = 4\sin^2 r\,(\cos^2\tfrac{1}{2}a + \cos^2\tfrac{1}{2}b + \cos^2\tfrac{1}{2}c) \qquad (\text{VIII.})$$

(plane)
$$\left(\frac{\delta}{\rho}\right)^2 + \left(\frac{\delta'}{\rho'}\right)^2 + \left(\frac{\delta''}{\rho''}\right)^2 + \left(\frac{\delta'''}{\rho'''}\right)^2 = \left(\frac{r}{\rho}\right)^2 + \left(\frac{r}{\rho'}\right)^2 + \left(\frac{r}{\rho''}\right)^2 + \left(\frac{r}{\rho'''}\right)^2 \qquad (9.)$$

(sphere)
$$\left(\frac{\sin\delta}{\sin\rho}\right)^2 + \left(\frac{\sin\delta'}{\sin\rho'}\right)^2 + \left(\frac{\sin\delta''}{\sin\rho''}\right)^2 + \left(\frac{\sin\delta'''}{\sin\rho'''}\right)^2 = \left(\frac{\sin r}{\sin\rho}\right)^2 + \left(\frac{\sin r}{\sin\rho'}\right)^2 + \left(\frac{\sin r}{\sin\rho''}\right)^2 + \left(\frac{\sin r}{\sin\rho'''}\right)^2 \qquad (\text{IX.})$$

The last two equations may be briefly expressed thus: —

(plane) $\Sigma\left(\frac{\delta}{\rho}\right)^2 = r^2\,\Sigma\left(\frac{1}{\rho}\right)^2$, (sphere) $\Sigma\left(\frac{\sin\delta}{\sin\rho}\right)^2 = \sin^2 r\;\Sigma\left(\frac{1}{\sin\rho}\right)^2$.

We have also in the sphere,

$$\Sigma\left(\frac{\cos\delta}{\sin\rho}\right)^2 = \cos^2 r\,\Sigma\left(\frac{1}{\sin\rho}\right)^2, \qquad \Sigma\left(\frac{\cos 2\delta}{\sin^2\rho}\right) = \cos 2r\,\Sigma\left(\frac{1}{\sin^2\rho}\right),$$

which in the plane become merely identical equations.

Finally, if we adopt the notation $\Sigma_2\,(x, y, z \ldots)$ to denote the sum of the products of $x, y, z \ldots$ taken two and two, we have the corresponding equations,

(plane)
$$\Sigma_2\left(\frac{1}{\alpha}, \frac{1}{\beta}, \frac{1}{\gamma}\right) = \tfrac{1}{4}\,\Sigma_2\left(\frac{1}{\rho}, \frac{1}{\rho'}, \frac{1}{\rho''}, \frac{1}{\rho'''}\right) \qquad (10.)$$

(sphere)
$$\Sigma_2\left(\frac{1}{\sin\alpha}, \frac{1}{\sin\beta}, \frac{1}{\sin\gamma}\right) = \tfrac{1}{4}\,\Sigma_2\left(\frac{1}{\operatorname{tang}\rho}, \frac{1}{\operatorname{tang}\rho'}, \frac{1}{\operatorname{tang}\rho''}, \frac{1}{\operatorname{tang}\rho'''}\right). \qquad (\text{X.})$$

4. To the above I add the following perhaps new expression of the relation between δ, r, and ϱ.

If we assume φ so that

$$\frac{1}{\sin\varphi} = \frac{1}{\sin\alpha} + \frac{1}{\sin\beta} + \frac{1}{\sin\gamma}$$

then it may be proved that

$$\frac{2}{\operatorname{tang}\varphi} = \frac{1}{\operatorname{tang}\rho} + \frac{1}{\operatorname{tang}\rho'} + \frac{1}{\operatorname{tang}\rho''} + \frac{1}{\operatorname{tang}\rho'''}$$

$$\cot\varphi = \cot\varrho + \operatorname{tang} r$$

$$\cos\delta\sin\varphi = \cos r\sin\varrho, \quad \cos\delta\cos\varphi = \cos(r-\varrho).$$

The last two equations are the most convenient for finding δ when r and ϱ are given. The equations for finding δ', δ'', δ''', are

$$\begin{aligned} \cos\delta'\sin\varphi' &= \cos r\sin\varrho', & \cos\delta'\cos\varphi' &= \cos(r+\varrho') \\ \cos\delta''\sin\varphi'' &= \cos r\sin\varrho'', & \cos\delta''\cos\varphi'' &= \cos(r+\varrho'') \\ \cos\delta'''\sin\varphi''' &= \cos r\sin\varrho''', & \cos\delta'''\cos\varphi''' &= \cos(r+\varrho''') \end{aligned}$$

and the relation between the auxiliaries φ, φ', φ'', φ''', is

$$\frac{1}{\sin\varphi} = \frac{1}{\sin\varphi'} + \frac{1}{\sin\varphi''} + \frac{1}{\sin\varphi'''}.$$

FROM A LETTER OF PROFESSOR PETERSEN TO THE EDITOR.

Altona, 1853, *February* 22.

I HAVE just received the following elements and ephemeris of *Thalia* from OELTZEN in Vienna.

Elements, — Computed from observations at Liverpool, December 16, Berlin, December 29, and Hamburg, January 11.

Epoch, 1852, December 29.37907, M. T. Greenwich.

	° ′ ″	
M	324 30 35.0	
☊	67 52 42.0	Mean Equinox, 1853.0.
i	10 19 27.0	
ω	54 44 27.7	
φ	12 31 26.1	
Log a	0.212976	
" μ	2.930543	

A slight error which occurred in the reduction of the fundamental right-ascensions and declinations to longitude and latitude is the occasion of the following residual differences in the α and δ deduced from the elements.

C. — O.	
s.	″
+0.13	—7.5
+0.16	—3.1
—0.03	—3.0

No account has been taken of parallax.

Ephemeris of the Twenty-third Asteroid.

Greenwich Mean Noon. 1853.	㉓ α	㉓ δ	Log △
	h. m. s.	° ′	
March 8	4 5 56	+25 14.6	0.31608
9	4 7 39	+25 21.3	
March 10	4 9 23	+25 27.9	
11	11 9	31.5	
12	12 55	41.0	0.32422
13	14 43	47.5	
14	16 32	25 53.9	
15	18 21	26 0.3	
16	20 12	6.6	0.33210
17	22 3	12.8	
18	23 56	18.9	
19	25 49	25.0	
20	27 43	31.0	0.33973
21	29 39	37.0	
22	31 35	42.8	
23	33 32	48.6	
24	35 30	54.3	0.34711
25	37 29	26 59.9	
26	39 28	27 5.4	
27	41 29	10.9	
28	43 30	16.2	0.35425
29	45 32	21.5	
30	47 35	26.6	
31	49 39	31.7	
April 1	4 51 43	+27 36.7	0.36115

A. C. PETERSEN.

NEW METHOD FOR THE INTEGRATION OF COMPLETE LINEAR EQUATIONS WITH CONSTANT COEFFICIENTS.

BY EDWARD COMBESCURE,
LICENTIATE IN MATHEMATICAL AND IN PHYSICAL SCIENCES.

THE integration of the complete linear equation is ordinarily reduced to that of the same equation deprived of that term which is a function of the only independent variable. In the case of constant coefficients, this last integration itself only depends upon the resolution of an algebraic equation of a degree equal to that of the equation proposed; and which, according as it presents merely simple roots, or admits multiple ones, gives immediately the general integral of the incomplete equation, or requires for obtaining it the employment of an artifice much used in analysis; namely, the making two equal roots to differ by an infinitesimal quantity which is made equal to zero after the desired transformations have been effected. When the integral of the complete equation is obtained, either by the method of variation of arbitrary constants, or by the method pointed out by Mr. CAUCHY,* (always supposing the roots of the algebraic equation under consideration to be unequal,) the artifice above mentioned still conducts by approximation to the integral of the equation proposed, in the case of equal roots, — as may be seen in detail by reference to LACROIX.

In my analysis I have followed the opposite course, and I suppose at once the roots of the algebraic equation to be formed of groups of multiple roots of any order whatever, which includes the case of unequal roots by supposing the exponent of each of these groups equal to unity. But instead of considering, at first, any function whatever of the independent variable, I suppose that the second member of the linear equation only contains one simple exponential; and since any function can be represented by a sum of such terms, I pass at once from the particular to the more general case; which method presents a remarkable analogy to the integration by exponentials of linear equations with partial differential coefficients.

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* DUHAMEL, *Cours d'Analyse*, Vol II. p. 75 and foll.

Let the linear equation of the nth order be,

$$(1)\qquad \frac{d^n y}{dt^n} + N_1 \frac{d^{n-1} y}{dt^{n-1}} + N_2 \frac{d^{n-2} y}{dt^{n-2}} + \ldots + N_{n-1} \frac{dy}{dt} + N_n y = f(t),$$

in which $N_1, N_2, \ldots N_n$ are constants, and $f(t)$ a function of the only independent variable t.

I shall consider the particular equation

$$(C)\qquad \frac{d^n y}{dt^n} + N_1 \frac{d^{n-1} y}{dt^{n-1}} + \ldots + N_n y = C e^{mt}$$

in which C and m are any parameters whatever.

Differentiating and subtracting from the result the equation C itself multiplied by m, we deduce

$$(c)\qquad \frac{d^{n+1} y}{dt^{n+1}} + N_1 \frac{d^n y}{dt^n} + \ldots + N_n \frac{dy}{dt} - m\left(\frac{d^n y}{dt^n} + N_1 \frac{d^{n-1}y}{dt^{n-1}} + \ldots + N_n y\right) = 0.$$

This linear equation of the order $n+1$ wanting the last term, I make in it in order to integrate it, according to the method,

$$y = e^{at},$$

which gives

$$(a^n + N_1 a^{n-1} + N_2 a^{n-2} + \ldots + N_n)\,(a - m) = 0.$$

So that, designating by a_α, $a_\beta \ldots a_\lambda$ the different roots of the equation

$$(a)\qquad a^n + N_1 a^{n-1} + \ldots + N_n = 0,$$

(a_α, $a_\beta \ldots a_\lambda$ representing the roots which enter α, $s \ldots \lambda$ times respectively in this equation), the integral of the equation (c) will be, as we know,

$$y = e^{n_\alpha t}(A_1 + A_2 t + \ldots A_\alpha t^{\alpha-1}) + \ldots + e^{a_\lambda t}(L_1 + L_2 t + \ldots + L_\lambda t^{\lambda-1}) + M e^{mt}.$$

$A_1, A_2 \ldots A_\alpha, \ldots L_1, L_2 \ldots L_\lambda$, are arbitrary constants in number equal to n, and M another constant which I will determine by the condition that y shall satisfy the equation (C) of which the equation (c) is a consequence. Having regard to the equation (a) and to the degree of multiplicity of the roots, the substitution of the preceding value of y in the equation (C) gives

$$M(m^n + N_1 m^{n-1} + N_2 m^{n-2} + \ldots + N_n) = b;$$

so that, taking for M its value deduced from this last equation, the general integral of the equation (C) will be

$$(\delta)\quad y = e^{a_\alpha t}(A_1 + A_2 t + \ldots + A_\alpha t^{\alpha-1}) + \ldots + e^{a_\lambda t}(L_1 + L_2 t + \ldots + L_\lambda t^{\lambda-1}) + \frac{C e^{mt}}{m^n + N_1 m^{n-1} + \ldots + N_n}.$$

I remark that the presence in the second member of the equation (C) of a new term, such as $C' e^{m't}$ would have no other effect than to introduce in the value (δ) of y the term

$$\frac{C' e^{m't}}{m'^n + N_1 m'^{n-1} + \ldots + N_n};$$

so that if this second member becomes $\Sigma\, C e^{mt}$, the last term of the value (δ) of y will change to

$$\Sigma \frac{C e^{mt}}{m^n + N_1 m^{n-1} + \ldots + N_n},$$

the symbol Σ referring to the values of C and of m.

For simplicity I will regard, for a moment, the presence of only one term.

I decompose the fractional expression

$$\frac{1}{m^n + N_1 m^{n-1} + \ldots + N_n}$$

into simple fractions.

Making

$$F(m) = m^n + N_1 m^{n-1} + N_2 m^{n-2} + \ldots + N_n,$$

and putting

$$\varphi(m) = \frac{(m - a_\alpha)^\alpha}{F(m)},\quad \psi(m) = \frac{(m - a_\beta)^\beta}{F(m)},\quad \varpi(m) = \frac{(m - a_\lambda)^\lambda}{F(m)},$$

the methods for effecting this decomposition will give

$$\frac{C e^{mt}}{m^n + N_1 m^{n-1} + \ldots + N_n} = \frac{\phi(a_\alpha)\, C e^{mt}}{(m - a_\alpha)^\alpha} + \frac{\phi'(a_\alpha)\, C e^{mt}}{(m - a_\alpha)^{\alpha-1}} + \frac{\phi''(a_\alpha)\, C e^{mt}}{1.2\,(m - a_\alpha)^{\alpha-2}} + \ldots + \frac{\phi^{\alpha-1}(a_\alpha)\, C e^{mt}}{1.2\ldots(a-1)\,(m - a_\alpha)}$$
$$+ \;.\;\;.\;\;.$$
$$+ \frac{\varpi(a_\lambda)\, b e^{mt}}{(m - a_\lambda)^\lambda} + \;.\;\;.\;\;. \;+ \frac{\varpi^{\lambda-1}(a_\lambda)}{1.2\ldots(\lambda-1)\,(m - a_\lambda)},$$

in which the accents denote, as usual, the successive derivatives.

I observe now that we have identically

$$\frac{C e^{mt}}{(m - a_\alpha)^\alpha} = \frac{e^{a_\alpha t}\, C e^{(m - a_\alpha)t}}{(m - a_\alpha)^\alpha} = e^{a_\alpha t} \int^{(\alpha)} C e^{(m - a_\alpha)t}\, dt\,\alpha = c^{a_\alpha t} \int C e^{mt} . e^{-a_\alpha t}\, dt^\alpha,$$

$\int^{\alpha)}$ denoting an indefinite integral of the order α, which should not introduce arbitrary constants.

By a similar transformation effected on its different terms, equation (δ) can be written

$$(\delta)\quad y = e^{a_\alpha t}(A_1 + A_2 t + \ldots + A_\alpha t^{\alpha-1}) + \ldots + e^{a_\lambda t}(L_1 + L_2 t + \ldots + L_\lambda t^{\lambda-1})$$
$$+ e^{a_\alpha t}\left(\varphi(a_\alpha)\int^{\alpha} e^{-a_\alpha t}\, C\, e^{mt}\, dt^\alpha + \varphi'(a_\alpha)\int^{\alpha-1} e^{-a_\alpha t}\, C\, e^{mt}\, dt^{\alpha-1} + \ldots + \frac{\phi^{\alpha-1}(a_\alpha)}{1.2\ldots(\alpha-1)}\int e^{-a_\alpha t}\, C\, e^{mt}\, dt\right)$$
$$+ \;\ldots$$
$$+ e^{a_\lambda t}\left(\varpi(a_\lambda)\int^{\lambda} e^{-a_\lambda t}\, C\, e^{mt}\, dt^\lambda + \varpi'(a_\lambda)\int^{(\lambda-1)} e^{-a_\lambda t}\, C\, e^{mt}\, dt^{\lambda-1} + \ldots + \frac{\varpi^{\lambda-1}(a_\lambda)}{1.2\ldots(\lambda-1)}\int e^{-a_\lambda t}\, C\, e^{mt}\, dt\right)$$

If now we suppose that the second member of the equation (C) receives a new term, $C' e^{m't}$, the value (δ') of y will receive a set of terms, which might be deduced from those which appear in this equation (δ'), by accenting the letters C and m: so that with the term

$$e^{a_\alpha t}\varphi(a_\alpha)\int^{(\alpha)} e^{-a_\alpha t}\, C\, e^{mt}\, dt^\alpha,$$

for example, we shall have

$$e^{a_\alpha t}\varphi(a_\alpha)\int^{(\alpha)} e^{-a_\alpha t}\, C'\, e^{m't}\, dt^\alpha;$$

the sum of which reduces to

$$e^{a_\alpha t}\varphi(a_\alpha)\int^{(\alpha)} e^{-a_\alpha t}\,(C\, e^{mt} + C'\, e^{m't})\, dt^\alpha.$$

Whence it results, that the second member of the equation (C) becomes

$$C\, e^{mt} + C'\, e^{m't} + C''\, e^{m''t} + \ldots = \Sigma\, C\, e^{mt} = f(t).$$

The term

$$e^{a_\alpha t}\varphi(a_\alpha)\int^{(\alpha)} e^{-a_\alpha t}\, C\, e^{mt}\, dt^\alpha$$

will become

$$e^{a_\alpha t}\varphi(a_\alpha)\int^{(\alpha)} e^{-a_\alpha t} f(t)\, dt^\alpha.$$

We shall have then for the general integral of equation (1),

$$(2)\quad y = e^{a_\alpha t}(A_1 + A_2 t + \ldots + A_\alpha t^{\alpha-1}) + \ldots + e^{a_\lambda t}(L_1 + L_2 t + \ldots + L_\lambda t^{\lambda-1})$$
$$+ e^{a_\alpha t}\left[\varphi(a_\alpha)\int^{(\alpha)} e^{-a_\alpha t} f(t)\, dt^\alpha + \varphi'(a_\alpha)\int^{(\alpha-1)} e^{-a_\alpha t} f(t)\, dt^{\alpha-1} + \ldots + \frac{\phi^{\alpha-1}(a_\alpha)}{1.2\ldots(\alpha-1)}\int e^{-a_\alpha t} f(t)\, dt\right]$$
$$+ \;\ldots$$
$$+ e^{a_\lambda t}\left[\varpi(a_\lambda)\int^{(\lambda)} e^{-a_\lambda t} f(t)\, dt^\lambda + \ldots + \frac{\varpi^{\lambda-1}\, a\lambda}{1.2\ldots(\lambda-1)}\int e^{-a_\lambda t} f(t)\, dt\right].$$

If we give to the definite integrals all their generality, they will themselves introduce the terms A_1, $A_2 t \ldots A_\alpha t^{\alpha-1} \ldots L_1 \ldots L_\lambda t^{\lambda-1}$; which will permit the expression (2) of y to be written a little more simply by suppressing the first line.

When the roots of the equation (a) are all unequal, designating them by $a, b, \ldots l$, and observing that $\varphi\, a = \frac{1}{F'(a)}$, equation (2) becomes

$$y = \frac{1}{F'(a)}\, e^{at}\int e^{-at} f(t)\, dt + \frac{1}{F'(b)}\, e^{bt}\int e^{-bt} f(t)\, dt + \ldots \frac{1}{F'(l)}\, e^{lt}\int e^{-lt} f(t)\, dt.$$

The formula (2) can be presented in a form in which only simple integrals enter. I resume for this purpose the development into simple fractions of the function $\frac{1}{F(m)}$.

Putting

$$\frac{1}{m - a_\alpha} = p, \quad \frac{1}{m - a_3} = q, \quad \frac{1}{m - a_\lambda} = r,$$

whence

$$\frac{1}{(m - a_\alpha)^2} = \frac{dp}{d a_\alpha}, \quad \frac{1}{(m - a_\alpha)^3} = \tfrac{1}{2}\frac{d^2 p}{d a^2_\alpha}, \quad \frac{1}{(m - a_\alpha)^\alpha} = \frac{1}{1.2\ldots(\alpha-1)}\frac{d^{\alpha-1} p}{d a_\alpha^{\alpha-1}}, \text{ \&c.,}$$

this development becomes

$$\frac{1}{F(m)} = \frac{1}{1.2\ldots(\alpha-1)}\left[\varphi(a_\alpha)\frac{d^{\alpha-1} p}{d a_\alpha^{\alpha-1}} + \frac{\alpha-1}{1}\varphi'(a_\alpha)\frac{d^{\alpha-2} p}{d a_\alpha^{\alpha-2}} + \frac{(\alpha-1)(\alpha-2)}{1.2}\varphi''(a_\alpha)\frac{d^{\alpha-3}}{d a_\alpha^{\alpha-3}} + \ldots + \varphi^{\alpha-1}(a_\alpha)\, p\right]$$
$$+ \;\ldots$$
$$+ \frac{1}{1.2\ldots(\lambda-1)}\left[\varpi(a_\lambda)\frac{d^{\lambda-1} r}{d a_\lambda^{\lambda-1}} + \frac{\lambda-1}{1}\varpi'(a_\lambda)\frac{d^{\lambda-1} r}{d a_\lambda^{\lambda-1}} + \ldots + \varpi^{\lambda-1}(a_\lambda)\, r\right].$$

Or observing that the quantities within the brackets are nothing more than the development of

$$\frac{d^{\alpha-1}(\phi(a_\alpha)\, p)}{d a_\alpha^{\alpha-1}}, \quad \frac{d^{\lambda-1}(\varpi(a_\lambda)\, r)}{d a_\lambda^{\lambda-1}},$$

we shall have

$$\frac{1}{F(m)} = \frac{1}{1.2\ldots(\alpha-1)}\frac{d^{\alpha-1}(\phi(a_\alpha)\, p)}{d a_\alpha^{\alpha-1}} + \ldots + \frac{1}{1.2.3(\lambda-1)}\frac{d^{\lambda-1}(\varpi(a_\lambda)\, r)}{d a_\lambda^{\lambda-1}}.$$

Or again, since

$$\varphi\,(a_\alpha) = \frac{1\,.\,2\,.\,3\,\ldots\,(\alpha-1}{F^{(\alpha)}\,(a_\alpha)}\,;$$

$$\frac{1}{F\,(m)} = \alpha\,\frac{d_{\alpha-1}}{d\,a_\alpha^{\alpha-1}}\left(\frac{1}{F^{(\alpha)}\,(a_\alpha)}\,\frac{1}{m-a_\alpha}\right) + \ldots + \lambda\,\frac{d_{\lambda-1}}{d\,a_\lambda^{\lambda-1}}\left(\frac{1}{F^{(\lambda)}\,(a_\lambda)}\,\frac{1}{m-a_\lambda}\right)$$

in which for p, q, r, their values have been restored. We shall have, then,

$$\frac{b\,e^{mt}}{F\,(m)} = \alpha\,\frac{d_{\alpha-1}}{d\,a_\alpha^{\alpha-1}}\left(\frac{1}{F^{(\alpha)}\,(a_\alpha)}\,\frac{C\,e^{mt}}{m-a_\alpha}\right) + \ldots + \lambda\,\frac{d^{\lambda-1}}{d\,a_\lambda^{\lambda-1}}\left(\frac{1}{F^{(\lambda)}\,(a_\lambda)}\,\frac{C\,e^{mt}}{m-a_\lambda}\right)$$

$$= \alpha\,\frac{d_{\alpha-1}}{d\,a_\alpha^{\alpha-1}}\left(\frac{1}{F^{(\alpha)}\,(a_\alpha)}\,e^{a_\alpha t}\int e^{-a_\alpha t}\,C\,e^{mt}\,d\,t\right) + \ldots$$

Whence we conclude, from the considerations already employed,

$$\begin{aligned} y = {} & e^{a_\alpha t}\,(A_1 + A_2\,t + \ldots + A_\alpha\,t^{\alpha-1}) + \ldots + e^{a_\lambda t}\,(L_1 + L_2\,t + \ldots + L_\lambda\,t^{\lambda-1}) \\ & + \alpha\,\frac{d_{\alpha-1}}{d\,a_\alpha^{\alpha-1}}\left(\frac{1}{F^{(\alpha)}\,(a_\alpha)}\,e^{a_\alpha t}\int e^{-a_\alpha t} f\,(t)\,d\,t\right) \\ & + \;.\;\;.\;\;. \\ & + \lambda\,\frac{d_{\lambda-1}}{d\,a_\lambda^{\lambda-1}}\left(\frac{1}{F^{(\lambda)}\,(a_\lambda)}\,e^{a_\lambda t}\int e^{-a_\lambda t} f\,(t)\,d\,t\right). \end{aligned}$$

LETTER FROM LIEUTENANT GILLISS TO THE EDITOR.

Washington, 1853, *March* 9.

THE latitude assigned to the Observatory at Santiago de Chile, in the table published in the *Astronomical Journal*, and in the *American Ephemeris*, is —32° 26′ 24″.8.

The information was derived from a letter to the late Professor S. C. WALKER published in No. 39 of the *Astronomical Journal*, where it is similarly erroneous. It is correctly written —33° 26′ 24″.8, in the original draft of my letter to Mr. WALKER, and the discrepancy no doubt occurred when my letter was copied by the clerk.

J. M. GILLISS.

NEW WORKS.

1. *Astronomische Beobachtungen auf der Sternwarte der Königlichen Rheinischen Friedrich-Wilhelms-Universität zu Bonn, angestellt und herausgegeben von* Dr. FR. W. A. ARGELANDER. — *Zweiter Band. Durchmusterung des südlichen Himmels zwischen* 15 *und* 31 *Grad der Declination. Erste Abtheilung.* Bonn, 1852. — This volume contains the first division of the observations intended as the continuation in the southern direction of BESSEL's Zones. After having assisted BESSEL in the observations of the zones from —15° to +45°, the indefatigable ARGELANDER undertook the farther prosecution of the work, and, assisted by KYSAEUS and HENKEL, extended it to +80°. This labor was completed in 1844, and the results are contained in the first volume of the series whose title is given above. But the region of the heavens below —15° was as yet only partially known, and now the same zeal and assiduity have been turned in this direction, and astronomy has become yet more indebted to the labors of ARGELANDER. It is to be hoped that the remaining portion of the work may speedily appear, and that computers may then be ready to undertake for these zones what has already been done for part of BESSEL's and for ARGELANDER's previous work, — the reduction of all their stars to the mean place at the given epoch.

2. *Logarithmorum* VI. *Decimalium Nova Tabula Berolinensis et Numerorum Vulgarium ab* I. *usque ad* 100,000 *et Functionum Trigonometricarum ad Decades Minutorum Secundorum. Auctore* CAROLO BREMIKER, Dr. Phil. Berlin, 1852. — The computing astronomer will welcome these carefully prepared and elegant tables of six-figure logarithms, which, with so much less labor, will afford all the precision requisite for a great part of those astronomical calculations for which seven figures are now generally used. The name of Dr. BREMIKER is a sufficient guaranty for care to secure avoidance of typographical error, and correctness of the last decimal place. The agreeable size of the page (7⅝ inches by 4) and the elegant

and convenient arrangement of the lines cannot fail to be appreciated by the practised computer, and seem to reduce the labor of using the tables nearly to a minimum.

In a Latin introduction practical rules are given for the numerical solution of triangles, and formulas for determining the probable and mean errors of logarithmic calculations, whatever the formula of computation.

3. *Die Reformation der Sternkunde. Ein Beitrag zur deutschen Culturgeschichte, von* E. F. Apelt. Jena, 1852. — Professor Apelt, already eminent for his profound investigations relative to the astronomical theories and discoveries of the time of Keppler, has now offered another important contribution to the history of astronomy during an epoch in which it is most difficult of investigation, and had long lain hidden in mystery and chaos. By the aid especially of the original correspondence of Keppler and D. Fabricius, — preserved at Pulkowa among the collection of Keppler's manuscripts, and intrusted to Professor Apelt for his investigation, — he has been enabled "to fill a blank page" in astronomical history.

The first part of the book relates to this history from the time of Nicholas of Cusa to Keppler, — the second, to the two men Keppler and Fabricius; and the work will be found alike attractive and indispensable to the student of the history of astronomy.

4. *Briefwechsel zwischen* W. Olbers *und* F. W. Bessel, *herausgegeben von* Adolph Erman. *In zwei Bänden.* Leipzig, 1852. — The intercourse of Olbers and Bessel commenced worthily of both, — in the reverential admiration of the stripling, on the one hand, for the genius and labors of an astronomer who wore his laurels as worthily and gracefully as he had earned them nobly, and, on the other hand, in the generous aid which it was ever the delight of Olbers to extend to younger aspirants for scientific attainments, — and ripened into a devoted friendship which continued for thirty-five years. During this period their own exertions, conjoined with those of Gauss and a few others, and succeeded by the zealous labors of Schumacher, Encke, Argelander, Peters and their honored colleagues, had raised Germany to the proud position in astronomical science which she at present occupies, and which a younger generation is so worthily upholding. Throughout these thirty-five years, the two friends maintained a constant correspondence, and the present work contains such portions as can now with propriety be given to the public.

In these letters the origin of Bessel's great works may be seen and their progress traced, — as also that of German astronomy in general. They are published by Bessel's son-in-law, and additional value given to the edition by the superintendence of Professor d'Arrest, who has conducted the work through the press.

Two biographical memoirs are prefixed, both written by Bessel; — the first an autobiography, the other a tribute to Olbers. The latter closes with the following words: —

"I have been compelled to limit myself to pointing out the circumstances which will carry the name of Olbers to posterity, '*ære perennius*.' Every one knows more of them than I could say here, yet I have not suppressed this little, that a circle among whom Olbers would have shined had he still lived might not be left without some memento of the astronomer. Those who belonged to him will find in the description of his excellence as a physician and as a man, rich material for the expression of their veneration. But I, too, have venerated him. He was to me the noblest friend, — with wise and fatherly counsel he guided my youth, — a hundred and seventy-one letters from him, which I possess, are written evidence of my right to extend my reverence for him beyond the limits of science. Hundreds of hours passed with him are indelible from my memory; with each one is associated the remembrance of some noble expression, of some judgement, clear-sighted concerning facts, charitable concerning men. Great, and always the same, he stands before my eyes, — whether in the time of his full manhood in 1804, or of his advanced age in 1837.

"May some more skilful hand succeed in transmitting to posterity the image which he has impressed and preserved in my memory."

Thank God, the race of such men was not extinct with Olbers.

G.

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OBSERVATIONS OF BIELA'S COMET.

LETTER FROM PROFESSOR HUBBARD TO THE EDITOR.

Observatory, *Washington*, 1853, *March* 15.

Professor Challis having kindly communicated the following hitherto unpublished observations of Biela's Comet in 1845–46, with the request that, after using, I would send them to the *Astronomical Journal*, I herewith inclose them, concurring entirely in his remark, that "the recent return of this comet, and its again appearing double, give a new interest to the observations of the two bodies made in 1845 and 1846."

J. S. HUBBARD.

OBSERVATIONS OF BIELA'S COMET,

MADE WITH THE NORTHUMBERLAND EQUATORIAL, AT THE CAMBRIDGE (ENG.) OBSERVATORY, IN THE YEARS 1845 AND 1846.

[Corrected for refraction.]

I. *The Following and Southern Comet.*

Greenwich Mean Time of Observation.	Apparent R.A. of Comet.	Log $\frac{p}{P}$	No. of Comp.	Apparent N. P. D. of Comet.	Log $\frac{q}{P}$	No. of Comp.	Designation of Star.
d. h. m. s.	h. m. s.			° ′ ″			
1845, Dec. 1 6 47 16.0				86 46 46.1	—9.8732	3	*a*
7 1 55.7	22 30 8.27	8.1005	5				
3 7 29 18.5	22 32 19.19	8.1536	3				*b*
7 53 10.0				87 4 21.8	—9.8805	5	
19 6 4 31.6	22 55 54.19	8.0370	3				*c*
6 42 6.8				88 51 1.7	—9.8895	4	
6 44 23.5	22 55 57.13	8.2451	1				*d*
6 54 44.5	22 55 57.91	8.2838	2				*c* and *d*
7 19 15.9				88 51 12.1	—9.8901	2	
23 7 49 0.6	23 3 39.40	8.3897	4				*e*
8 4 36.0				89 10 52.7	—9.8926	5	
30 6 33 36.8	23 18 31.20	8.2809	7				*f*
8 18 46.7				89 39 55.2	—9.8947	5	
1846, Jan. 1 6 28 9.1				89 46 57.9	—9.8946	1	*g*
8 50 45.8				89 47 21.5 ?	—9.8952	1	*g* and *h*
9 6 27.8	23 23 26.61	8.5758	4	89 47 9.6	—9.8953	4	*h*
15 6 53 21.4	0 0 41.09	8.4022	4	90 36 25.9	—9.8986	4	*i*
23 7 1 18.1	0 26 1.07	8.4318	7	91 11 32.3	—9.9010	7	*k*
24 7 2 58.8	0 29 23.93	8.4385	4	91 16 45.3	—9.9013	4	*k*
27 6 23 40.0	0 39 44.45	8.3150	3				*l*
6 31 0.5				91 33 46.5	—9.9032	4	
28 6 19 7.5	0 43 18.43	8.3313	4	91 39 53.4	—9.9039	4	*m*
29 7 6 51.4	0 47 3.25	8.4508	4	91 46 39.4	—9.9031	4	*m*
Feb. 11 7 42 45.6	1 39 43.64	8.5114	2				*n*
7 55 31.3				93 45 53.8	—9.9073	5	
12 7 20 34.5				93 57 46.4	—9.9106	3	*o*
13 8 29 46.8	1 48 59.59	8.5660	2	94 11 2.8	—9.9055	2	*p*
24 7 58 23.5	2 45 37.44	8.5150	2	97 0 1.3	—9.9172	2	*q*
8 38 12.3	2 45 46.65	8.5634	2	97 0 32.4	—9.9114	2	*r*

Greenwich Mean Time of Observation.		Apparent R.A. of Comet.	Log $\frac{p}{P}$	No. of Comp.	Apparent N. P. D. of Comet.	Log $\frac{q}{P}$	No. of Comp.	Designation of Star.
d.	h m. s.	h. m. s.			° ′ ″			
1846, Feb. 25	7 50 38.1	2 51 24.09	8.4993	4				*s*
	7 51 41.0				97 17 45.7	—9.9190	6	
27	8 1 20.6	3 3 29.03	8.5108	4	97 54 52.4	—9.9198	4	*t*
	8 52 55.7	3 3 41.96	8.5725	1	97 55 22.6	—9.9113	1	*u*
28	7 34 3.1	3 9 36.10	8.4592	3	98 13 11.9	—9.9249	3	*v*
Mar. 2	8 8 34.2	3 22 36.66	8.5108	4	98 51 52.4	—9.9220	4	*w*
5	7 37 27.4	3 42 51.58	8.4414	3	99 49 47.7	—9.9310	3	*x*
10	7 8 19.6	4 19 40.10	8.3240	2	101 24 41.3	—9.9425	2	*y*
	7 30 29.3	4 19 47.79	8.3865	4				*z*
	7 30 40.1				101 25 2.3	—9.9393	5	
20	9 7 50.6	5 43 48.82	8.5033	2	103 54 22.1	—9.9346	2	*aa* and *bb*
24	8 6 9.4	6 18 26.06	8.3091	8				*cc*
	8 22 49.4				104 21 27.2	—9.9493	7	
25	7 47 8.8	6 27 0.58	8.2183	2				*dd*
	8 3 55.5				104 28 49.0	—9.9534	2	
	9 11 37.6	6 27 31.13	8.4684	1	104 29 8.7	—9.9405	1	*ee* and *ff*
27	8 44 25.6				104 34 3.2	—9.9483	2	*gg*
	9 20 1.1	6 44 44.96	8.4461	1				
29	8 16 45.9				104 34 57.1	—9.9544	3	*hh*
	8 22 49.6	7 1 18.93	8.2851	2				
April 1	9 34 42.3				104 28 27.2	—9.9422	4	*ii*
	9 45 37.1	7 26 10.57	8.4740	6				
13	8 54 1.4	8 49 12.00	8.2108	7				*kk*
	9 4 38.9				103 1 36.1	—9.9500	3	
	9 12 52.9				103 1 39.3	—9.9489	1	*kk*, *ll*, and *mm*.
	9 20 56.8	8 49 20.85	8.3180	1				

II. *The Preceding and Northern Comet.*

Greenwich Mean Time of Observation.		Apparent R.A. of Comet.	Log $\frac{p}{P}$	No. of Comp.	Apparent N. P. D. of Comet.	Log $\frac{q}{P}$	No. of Comp.	Designation of Star.
d.	h. m. s.	h. m. s.			° ′ ″			
1846, Jan. 23	7 16 43.3	0 25 57.85	8.4624	5				*k*
	7 20 52.3				91 9 30.8	—9.9007	4	
24	7 1 19.6	0 29 18.59	8.4348	5	91 14 37.9	—9.9012	5	*k*
27	6 21 16.2	0 39 38.26	8.3380	3				*l*
	6 29 40.7				91 31 21.2	—9.9030	4	
	6 48 3.9	0 39 42.48	8.4098	1	91 31 26.7	—9.9028	1	*l′*
28	6 19 14.2	0 43 12.67	8.3317	5	91 37 21.2	—9.9037	5	*m*
29	7 7 12.5	0 46 58.06	8.4512	5	91 44 4.1	—9.9029	5	*m*
Feb. 12	7 16 16.1				93 53 30.3	—9.9106	3	*o*
13	8 23 36.1	1 48 50.19	8.5600	2	94 6 34.4	—9.9059	2	*p*
24	7 52 35.3	2 45 22.28	8.5068	2	96 53 37.8	—9.9176	2	*q*
	8 32 36.5	2 45 31.87	8.5578	2	96 54 7.7	—9.9120	2	*r*
25	7 41 47.2	2 51 8.13	8.4851	4	97 11 7.3	—9.9199	4	*s*
27	8 3 51.7	3 3 14.49	8.5147	4	97 48 0.9	—9.9191	4	*t*
28	7 31 28.9	3 9 18.60	8.4181	3	98 6 3.9	—9.9245	3	*v*
Mar. 2	8 8 16.9	3 22 18.18	8.5105	6	98 44 26.8	—9.9217	6	*w*
5	7 29 29.4	3 42 28.00	8.4250	4	99 41 44.8	—9.9317	4	*x*
	8 1 51.1	3 42 36.60	8.4900	1	99 42 21.7	—9.9267	1	*x* and *x′*
27	8 41 37.6				104 26 5.5	—9.9484	2	*gg*

Adopted Mean Places, 1846.0, *of the Stars of Comparison.*

Designation of Star.	Name in Catalogues.	Adopted Mean R.A. 1846.0.	Adopted Mean N. P. D. 1846.0.	Authority for the Adopted Place.
		h m. s.	° ′ ″	
a	Piazzi XXII. 169	22 31 1.80	86 16 6.40	Cambridge Observations.
b	Weisse XXII. 772	22 36 0.03	86 55 59.03	" "
c	" 1228	22 57 35.20	89 3 48.05	" "
d	*A* Piseium	23 0 47.70	88 42 33.48	" "
e	Piazzi XXIII. 21	23 7 45.71	89 31 41.31	" "

Designation of Star.	Name in Catalogues.	Adopted Mean R.A. 1846.0.	Adopted Mean N. P. D. 1846.0.	Authority for the Adopted Place.
		h. m. s.	° ′ ″	
f	ϰ Piscium	23 19 2.28	89 35 10.86	Cambridge Observations.
h	9 Piscium	23 19 21.47	89 43 19.50	“ “
g	Weisse XXIII. 449	23 22 2.90	89 41 2.33	“ “
i	“ 1205	23 58 14.65	90 44 7.37	“ “
k	B. A. C. 147	0 27 38.70	91 21 8.94	“ “
l	Weisse O. 712	0 40 27.46	91 19 45.35	“ “
l′	“ 732	0 42 1.98	91 3 49.03	“ “
m	20 Ceti	0 45 8.33	91 58 53.10	“ “
n	Weisse I. 725	1 39 43.90	93 40 52.40	“ “
o	“ 790	1 43 47.28	93 24 3.73	“ “
p	“ 942	1 52 28.52	94 6 59.60	“ “
r	Weisse II. 742	2 42 41.30	97 26 47.0	Weisse's Catalogue.
q	“ 866	2 48 59.68	96 52 38.7	“ “
s	“ 970	2 54 32.36	97 5 50.1	Cambridge Observations for R.A. Weisse's Catalogue for N. P. D.
u	ϱ^3 Eridani	2 56 42.88	98 12 24.1	Cambridge Observations for R.A. B. A. C. for N. P. D.
t	Weisse III. 90	3 5 1.58	98 13 54.5	Weisse's Catalogue.
v	“ 278	3 15 47.19	98 20 10.4	“ “
w	“ 412	3 24 32.86	98 22 2.0	“ “
x	“ 924	3 47 12.04	99 58 45.1	“ “
x′	“ 965	3 49 15.23	100 12 10.6	“ “
z	Lalande 8431	4 20 31.34	101 28 24.9	Lalande's Catalogue.
y	“ 8479	4 21 37.90	101 23 57.6	“ “
bb	Weisse V. 1204	5 46 57.53	104 9 50.4	Weisse's Catalogue.
aa	η Leporis	5 49 23.63	104 11 59.8	B. A. C.
cc	Weisse VI. 544	6 18 1.44	104 25 23.5	Weisse's Catalogue.
dd	“ 809	6 26 18.71	104 42 7.4	“ “
ff	“ 990	6 32 14.76	104 0 45.8	“ “
ee	11 Canis Majoris	6 39 49.59	104 15 54.6	B. A. C.
gg	Weisse VI. 1351	6 43 46.44	104 31 1.4	Weisse's Catalogue.
hh	Piazzi VI. 328	6 58 31.85	104 38 31.3	Piazzi's Catalogue.
ii	Weisse VII. 835	7 26 43.56	104 11 45.6	Weisse's Catalogue.
ll	Lalande 17647	8 48 27.24	103 27 13.2	Lalande's Catalogue.
mm	“ 17662	8 48 56.02	103 19 4.2	“ “
kk	Anonymous	8 49 34.82	103 6 22.3	Cambridge Equatorial Observations.

The following determinations of the apparent relative positions of the two comets are partly derived from the foregoing observed R.A. and N. P. D., and partly depend on separate comparisons of the two comets with each other. The weight of each determination is estimated from the number of such comparisons and the number of times that that comet which was compared fewer times than the other was compared with stars.

Greenwich Mean Time.	Difference of R.A.	Difference of N. P. D.	Angle of Position.	Distance.	Weight of Determination.
d. h. m.	s.	″	° ′	″	
1846, Jan. 23 7 8.2	5.18	122.96	327 43	145.44	4
24 7 1.3	5.11	126.57	328 48	147.96	4
27 6 25.5	5.84	144.61	328 48	169.06	3
28 6 19.2	5.77	151.09	330 12	174.11	4
29 7 22.8	5.44	154.43	332 10	174.63	7
Feb. 11 7 23.3	7.38	249.74	336 8	273.11	4
12 7 8.8	7.86	252.71	335 3	278.72	5
13 7 31.0	8.30	264.95	334 54	292.58	5
24 8 12.6	13.59	378.07	331 51	428.79	7
25 7 14.3	13.99	389.48	331 52	411.66	9
27 8 1.3	15.30	413.04	331 10	471.51	6
28 7 31.5	16.72 ?	425.52 ?	329 44	492.68	2
Mar. 2 8 8.3	18.40	412.93	328 22	520.22	4
5 7 36.7	21.46	471.39	326 4	568.14	3
20 8 53.9	41.28	558.61	312 54	820.56	2
25 8 50.7	46.32 ?	503.27 ?	323 12	840.12	2
27 9 7.3	47.42 ?	470.93 ?	325 38	834.02	1

The above differences are corrected for refraction.

FIRST COMET OF 1853.

OBSERVATIONS MADE AT THE OBSERVATORY OF HARVARD COLLEGE, ON THE COMET DISCOVERED BY MR. C. W. TUTTLE.

[Communicated by W. C. Bond, Esq.]

	h. m. s.	Δα ☄ — ✱ m. s.	No. Obs.	Δδ ☄ — ✱ ′ ″	No. Obs.	Comparison-Star.
1853, March 8	8 28 4.5	+0 15.18	7	−0′ 0″.8	6	*a*
	9 23 53.5	−0 5.42	6	−1 43.9	4	*b*
10	7 10 42.5	+0 34.97	6	−6 27.4	3	*c*
	8 22 21.5	+0 30.92	8	−1 33.0	6	*c*
14	7 49 2.2	+1 16.78	6	−4 53.7	3	*d*
	9 37 42.8	+1 11.70	12	+0 14.1	3	*d*
18	9 23 11.5	−0 6.90	5	+1 53.7	4	*e*
22	7 56 15.1	+1 26.47	6	+4 31.2	6	*f*

Comparison-Stars referred to Apparent Equinox.

	α h. m. s.	δ	Mag.	
a	4 46 35.09	−10° 59′ 47″.6	10.11	Compared with Weisse, H. IV. No. 1031.
b	4 46 50.96	−10 53 30.1	9	Weisse, H. IV. No. 1031.
c	4 43 54.93	− 7 21 26.5	11	Compared with Lalande, No. 9068.
d	4 38 19.67	− 1 49 17.9	11	Compared with Weisse, H. IV. No. 809.
e	4 36 31.06	+ 2 7 42.6	9	Compared with Weisse, H. IV. No. 774.
f	4 32 56.76	+ 5 2 53.1	9	Weisse, H. IV. No. 720.

COMET.

	Cambridge M. T. h. m. s.	α h. m. s	δ
March 8	8 28 4.5	4 46 50.27	−10° 59′ 48″.4
	9 23 53.5	4 46 45.54	−10 55 14.0
10	7 10 42.5	4 44 29.90	− 7 27 53.9
	8 22 21.5	4 44 25.85	− 7 22 59.5
14	7 49 2.2	4 39 36.45	− 1 54 11.6
	9 37 42.8	4 39 31.37	− 1 49 3.8
18	9 23 11.5	4 36 24.16	+ 2 9 36.3
22	7 56 15.1	4 34 23.23	+ 5 7 24.3

From the observations of the 10th, 14th, and 18th, Mr. Tuttle has derived the following elements: —

T	1853, Feb. 23^d.8862, Greenwich M. T.	
π	153° 38′ 16″	Apparent Equinox, 1853, March 14.
☊	70 19 27	
i	20 30 48	
Log. q	0.039177	
	Motion Retrograde.	

Comet appears round, with the light rapidly condensing towards the center. Apparent diameter about three minutes.

ON THE ORBIT OF BIELA'S COMET IN 1845-46.

By PROFESSOR J. S. HUBBARD,

OF THE WASHINGTON OBSERVATORY.

Since the appearance of Biela's Comet in 1845-46, a new interest has attached to the investigation of its motions. It is important to ascertain, if possible, whether there be mutual action between the two bodies into which the comet has been resolved, sufficient to produce effects sensible to us; — or whether, as is more probable from the almost shadowy nature of these bodies, their separate motions be entirely independent of each other. The changes of relative position of the two comets were so nearly uniform, as to render it probable that any disturbing effects of this kind will be manifested by a variation of the elliptic elements rather than of the geocentric place during the short period of the comet's visibility, and that the best method of detecting them will be by a comparison of the osculating elements at previous and subsequent returns to the perihelion. I have here endeavored to furnish one of these points of comparison, by determining elements which shall best represent the observed paths of the two nuclei in 1845–46, hoping that others, probably already in the field, will soon be able to bring together by a single theory all the recorded appearances of the comet.

§ 1.

The elements assumed as the basis of operations are those given by **Plantamour** for the primary nucleus, (¹) and which, from the comparisons made by him, (²) appeared to give already a close representation of the observed places. I have used them in the following form: —

1846, February 11.0, M. T. Greenwich.
Mean Equinox, 1846.0.

M	$0^\circ\ 0'\ 6''.61$
☊	$245\ 54\ 38.80$
ω	$223\ \ 7\ 41.30$
i	$12\ 34\ 53.47$
φ	$49\ 12\ \ 2.50$
μ	$536''.23625$

Relatively to the equator, we have also, —

$☊_0$	$327^\circ\ 3'\ 55''.06$
ω_0	$139\ 36\ \ 6.08$
i_0	$21\ 27\ 15.94$

I proceeded first to compute, by **Brünnow**'s method, (³) the perturbations of radius-vector, argument of latitude and coördinate z perpendicular to the equator, taking the places of the disturbing planets from the English *Nautical Almanac*, and assuming for the logarithms of the masses the following: —

Mercury,	3.31285	*Mars*,	3.57181
Venus,	4.39595	*Jupiter*,	6.97969
Earth,	4.41916	*Saturn*,	6.45573

For *Mercury*, *Venus*, and the *Earth*, the forces were computed for intervals of four days from 1845, November 13, to 1846, May 12; — for *Mars* the intervals were of twelve, and for *Jupiter* and *Saturn* of twenty days. Thence, by interpolating and uniting together the forces in each direction, I obtained the values given below, and by integrating from February 11.0, the epoch of perihelion passage, I obtained the variations of the coördinates, — the forces being expressed in units of the tenth, and δr, δz in units of the seventh decimal place. These results were afterwards verified by an independent computation of the variation of elements and comparison of geocentric places.

	R	$S.r$	$Z.\cos i_0$	δr	δu	δz
1845, Nov. 13	+660	+1968	−433	−61.29	−1″.083	−8.85
17	632	1859	469	62.57	1.112	4.45
21	660	1676	493	63.56	1.123	− .51
25	704	1482	510	64.17	1.115	+2.93
29	744	1292	516	64.30	1.090	5.87
Dec. 3	760	1081	513	63.82	1.046	8.27
7	756	864	494	62.64	.986	10.15
11	672	624	458	60.70	.910	11.52
15	571	407	417	58.00	.822	12.40
19	438	217	372	54.58	.725	12.83
23	296	+ 65	338	50.53	.622	12.86
27	169	− 46	304	45.95	.516	12.51
31	+ 50	98	260	40.95	.413	11.81
1846, Jan. 4	− 70	107	200	35.65	.314	10.81
8	190	92	132	30.19	.224	9.57
12	312	60	− 56	24.73	.146	8.15
16	430	− 31	+ 20	19.41	.082	6.63
20	545	+ 5	99	14.42	.034	5.10
24	653	55	175	9.95	− .003	3.64
28	749	119	245	6.14	+ .012	2.33
Feb. 1	839	186	312	3.17	.014	1.25
5	914	264	368	1.14	.009	.47
9	974	348	418	.12	.002	.05
13	1016	444	460	.12	.001	.05
17	−1040	+544	+492	−1.07	+ .017	+ .52

(¹) *Astr. Nachr.*, XXV. p. 125.

(²) *Ibid.*, p. 126.

(³) *Ibid.*, No. 808.

	R	$S.r$	$Z.\cos i_0$	δr	δu	δz
1846, Feb. 21	—1045	+654	+517	—2.85	+.″054	+1.46
25	1034	773	540	5.26	.118	2.92
March 1	1008	893	560	8.12	.212	4.89
5	974	1016	579	11.17	.337	7.39
9	944	1136	593	14.20	.491	10.43
13	926	1250	594	17.01	.672	14.00
17	928	1346	575	19.44	.876	18.10
21	947	1400	532	21.38	1.099	22.68
25	962	1396	469	22.78	1.335	27.70
29	949	1314	398	23.60	1.581	33.09
April 2	898	1260	325	23.81	1.832	38.76
6	814	1161	260	23.37	2.083	44.64
10	707	1061	205	22.25	2.331	50.65
14	590	971	162	20.39	2.573	56.75
18	471	887	131	17.74	2.807	62.87
22	354	809	110	14.25	3.032	69.00
26	242	740	97	9.88	3.246	75.12
30	141	674	90	— 4.59	3.449	81.20
May 4	— 45	614	87	+ 1.66	3.640	87.24
8	+ 43	555	89	8.89	3.820	93.24
12	+127	+500	+91	+17.13	+3.987	+99.21

In computing the ephemeris for comparison with observations, the reduction of coördinates to the true equinox and equator was effected by HANSEN's method, (¹) and the sun's coördinates as taken from the *Nautical Almanac* were corrected for the effect of aberration in the radius-vector, and for the sun's latitude, by help of the very convenient Tables given by GÖTZE ; (²) the remainder of the computation being performed in the usual manner.

§ 2.

In addition to the usual reductions for parallax and aberration, I have applied to some of the observations, before comparison, small corrections, necessary to reduce the assumed places of the stars to the result of later determinations, or for the sake of uniformity where the same star has been used by more than one observer. The authorities for these corrections are given by their initials, which designate respectively,

C.	Cambridge (Eng.). (*Astr. Journ.*, III. pp. 58, 59.)
Cp.	Cape of Good Hope. (*Astr. Nachr.*, XXX. p. 111.)
D.	Dorpat. *Stellarum Fixarum imprimis Duplicium*, etc., 1852.
G.	Greenwich Observations, 1846 – 47, and Twelve-Year Catalogue.
H.	Hamburg. *Mittlere Oerter von 12,000 Fixsternen.*
K.	Königsberg Observations, XXIV. p. 112.
M.	Madras Observations.
P.	Piazzi's Catalogue.
V.	Vienna Observations.
W.	Washington Observations, 1846 – 47.

The subjoined tables contain all the observations I have been able to collect, and the result of comparison with the assumed elements.

BERLIN. (*Astr. Nachr.*, XXVI. p. 1.)

Date.	M. T. Greenwich.	α	δ	C. — O. $\Delta\alpha$	C. — O. $\Delta\delta$	Star.	$d\alpha$	$d\delta$	Authority.
1845, Nov.	d. 28.21535	336° 49′ 5″.8	+3° 40′ 32″.1	—19″.1	+51″.6	1 . 2 . 3	+4″.0	—5″.2	D.
	29.24898	337 2 54.5	3 31 23.0	+ 1.4	13.5	"	"	"	"
Dec.	2.29067	337 48 47.2	3 4 8.6	+ 7.3	+ 8.5	"	"	"	"
	21.23359	344 51 5.4	+0 59 11.7	— 8.9	— 7.5	4	—3.1	4.0	C.
1846, Jan.	27.30917	9 58 42.6	—1 33 50.1	— 7.4	+ 3.4	5 6	—3.4 +1.2	—0.8 +6.4	H., W. M., W.
	28.28759	10 51 6.2	1 40 0.8	+ 3.2	7.3	7	6.4	—0.7	C., G., K.
Feb.	6.31581	19 33 48.8	2 51 43.4	— 2.2	4.4	8	9.2	+3.2	G.
	18.25841	33 12 6.9	—5 19 55.4	+ 7.7	+10.0	9	+2.2	—7.6	Cp., W.

(¹) *Ermittelung der absoluten Störungen, &c.*, p. 79.

(²) *Astr Journ.*, II. pp. 71 et seq.

Date. M. T. Greenwich.	α	δ	C. — O.		Star.	dα	dδ	Authority.
			Δα	Δδ				
1846, Feb. 24ᵈ.27092	41° 19′ 21″.8	—6° 58′ 46″.6	+14″.1	— 1″.3				
26.28778	44 17 13.1	7 35 16.7	19.2	+ 7.0	11	+2″.7	+1″.5	Cp.
Mar. 2.30214	50 35 57.0	8 52 12.6	20.0	76.9				
4.33150	54 0 25.8	9 30 17.9	34.3	1.3	13	2.6	—0.6	Cp., G.
7.32590	59 19 16.4	10 28 33.2	44.6	10.3				
10.29091	64 51 51.4	11 24 22.0	53.7	+ 0.9	15	7.3	+1.3	Cp.
12.32661	68 56 23.2	12 0 43.9	45.7	— 3.4				
20.35276	85 54 1.3	13 53 48.7	64.7	+ 2.9	17	+0.2	—1.5	Cp.
21.30711	87 59 18.4	14 2 45.4	59.2	— 0.7	18	—1.5	+1.1	C., G.
April 1.38447	111 30 52.8	14 28 5.4	+44.0	+21.1				
24.42921	146 22 27.1	—11 24 40.9	— 1.5	—16.7				

Nov. 28. Single instrumental position. (*Astr. Nachr.*, XXIII. p. 379.)

The given places of the first two stars of comparison are for 1845.0.

BONN. (*Astr. Nachr.*, XXIV. pp. 255, 295.)

Date. M. T. Greenwich.	α	δ	C. — O.		Star.	dα	dδ	Authority.
			Δα	Δδ				
1846, Feb. 21ᵈ.28448	37° 9′ 45″.2	—6° 7′ 52″.2	+10″.8	+ 9″.7	*a*	—274ˢ.83	— 13″.6	H., W.
26.29468	44 17 53.7	7 35 28.1	16.0	+10.8	*d*	— 0.47	0.2	Cp.
Mar. 6.29693	57 27 33.5	10 8 12.4	32.4	—17.3	*e*	+122.63	—805.4	Cp.
16.32588	77 13 3.6	13 4 20.0	42.2	—11.1	*f*	— 0.03	+ 1.3	D.
21.31057	88 0 6.7	14 2 54.9	38.1	+ 7.0	*h* { *A* *S*	+ 0.05 + 0.03	— 0.8 + 9.6	} G.
27.31435	101 3 18.4	14 33 57.8	59.5	+ 5.3	*i* { *A* *S*	— 0.07 0.51	+ 0.5 0.9	} Cp., V.
30.34017	107 15 9.8	14 32 43.8	531.8	—38.6	*k*	0.30	4.2	H., W.
April 1.35892	111 27 54.2	14 28 9.6	40.1	+19.8				
2.33871	113 23 42.3 ::	14 24 14.3 ::	22.8 ::	24.3 ::				
13.34907	132 16 26.9	13 2 40.2	+31.3	+31.7				
23.38618	145 14 16.7	11 32 59.9	—52.6	—22.3	λ *Hyd.*	— 0.04	+ 0.7	H.
27.42836	149 31 20.6	—11 2 42.7	—41.1	+32.9	"	"	"	"

Feb. 21, March 6. The wrong star had been taken in the reductions.

March 21, 27. The two observers have assumed different places for the star of comparison.

CAMBRIDGE (ENG.). (*Astr. Journ.*, III. pp. 57, 58.)

Date. M. T. Greenwich.	α	δ	C. — O.		Star.	dα	dδ	Authority.
			Δα	Δδ				
1845, Dec. 1ᵈ.27736		+3° 13′ 20″.7		—12″.1				
.28755	337° 32′ 5″.7		+56″.4					
3.30657	338 4 49.8		+51.3					
.32314		2 55 45.1		14.7				
19.26414	343 59 0.9		— 3.6					
.28260		1 9 2.1		11.1				
23.32054	345 54 54.1		+ 1.0		} *e*	—0ˢ.03	+2″.4	C., H.
.33136		0 49 12.4		— 0.6				
30.26834	349 37 50.6		+ 7.5		} *f*	—0.02	—1.6	C., G., H.
.34138		0 20 14.2		+ 2.1				
1846, Jan. 1.35256		+0 13 0.6		— 8.6				
.37455	350 51 45.0		— 3.6					
15.28258	0 10 21.0	—0 36 18.2	9.1	+ 5.2	*i*	+0.03	1.0	C., K.
23.28842	6 30 19.9	1 11 22.9	5.1	3.5	*k*	—0.06	0.1	C., Cp., W.
24.28963	7 21 3.0	1 16 35.8	3.5	3.1	"	"	"	"
27.26246	9 56 12.1		6.3		} *l*	+0.08	1.6	C., H., K., W.
.26756		1 33 38.1		6.7				
28.25936	10 49 41.1	1 39 44.3	— 3.3	1.6	*m*	+0.04	—1.0	C., G., K.
29.29255	11 45 54.7	—1 46 30.2	+ 1.6	+ 1.9	"	"	"	"

Date. M. T. Greenwich.	α	δ	C. — O.		Star.	dα	dδ	Authority.
			Δα	Δδ				
d.	° ′ ″	° ′ ″	″	″		s.	″	
1846, Feb. 11.31810	24 56 4.3		+9.7		n	+0.16	— 2.3	C., H., W.
.32699		—3 45 43.9		— 2.3				
12.30274		3 57 33.9		4.4				
13.35084	27 15 2.1	4 10 52.6	6.4	0.3	p	—0.02	2.4	C., H., K., W.
21.34405	41 25 40.2	7 0 1.7	14.6	3.9				
25.32418	42 51 10.2		22.3					
.32491		7 17 30.2		— 7.6				
27.33886	45 53 3.9	7 54 42.5	23.5	+ 5.3				
28.31278	47 24 0.0	8 12 59.4	21.4	+ 4.4	v	0.66	— 3.9	Cp.
Mar. 2.33682	50 39 19.6	8 51 35.7	22.6	— 0.1				
5.31530	55 43 2.1	9 49 24.7	32.2	0.6	x	—0.02	+ 5.2	W.
10.30516	61 56 30.3		56.4		z	+0.42	+ 1.3	Cp.
.30628		11 24 36.2		— 1.9				
20.37831	85 57 23.4	13 54 2.4	63.4	+ 1.4	aa	—0.01	— 0.4	G., M., W.
24.33545	94 36 35.7		69.5		cc	0.15	+ 2.9	Cp.
.34702		14 24 4.0		0.6				
25.31179	96 47 48.6		73.1					
.34956		14 28 35.4		+ 1.3				
27.36198		14 33 40.2		—16.2	gg	—0.08	+10.7	Cp., G., V.
.38670	101 11 22.7		94.5					
29.34273		14 34 38.2		+ 0.1	hh	+0.22	— 0.9	Cp.
.34694	105 19 53.6		58.8					
April 1.39678		14 28 8.6		+27.1				
.40436	111 32 48.0		70.6					
13.37036	132 18 21.0		+30.5					
.37683		—13 1 21.3		—32.1				

March 27. Single comparison in α.

(*To be continued.*)

OBSERVATIONS OF THE FIRST COMET OF 1853,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury.]

[Corrected for refraction.]

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	☄ — *		☄'s apparent	
				Δα	Δδ	α	δ
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
March 14	8 23 17.3	6	Weisse IV. 809	+2 22.08	— 8 37.59	4 39 33.89	—1 51 23.43
15	8 7 33.9	9	(x)	—2 5.17	— 5 50.16	4 38.2	—0 43
19	8 48 2.9	10	Weisse IV. 751	+1 17.46	+16 19.88	4 35 49.46	+2 58 33.02
	8 59 58.0	2	" 806	—1 11.31	+ 3 17.28	4 35 49.26	+2 59 1.49

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse IV. 809	9	4 37 3.42	—1 42 59.18	Weisse's Catalogue.
(x)	9	4 40.3	—0 37	
Weisse IV. 751	8	4 34 23.44	+2 41 57.49	Weisse's Catalogue.
" 806	9	4 36 52.01	+2 55 29.34	"

Unfavorable weather prevented any further observation.

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Observations of Biela's Comet.
First Comet of 1853.
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THE

ASTRONOMICAL JOURNAL.

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VOL. III. CAMBRIDGE, 1853, APRIL 25. NO. 9.

ON THE ORBIT OF BIELA'S COMET IN 1845-46.

By PROFESSOR J. S. HUBBARD,
OF THE WASHINGTON OBSERVATORY.

(*Continued from page* 64.)

CAPE OF GOOD HOPE. (*Astr. Nachr.*, XXX. pp. 103, 111.)

Date. M. T. Greenwich.	α	δ	C. — O.		Star.	$d\,\alpha$	$d\,\delta$	Authority.
			$\Delta\,\alpha$	$\Delta\,\delta$				
d.								
1846, Feb. 18.30735	33° 15′ 53″.1		+5″.3					
.31977		—5° 20′ 43″.3		+ 2″.1				
19.30897		5 36 3.5		6.8	2	+0″.6	+1″.6	Cp., W.
.31133	34 33 15.1		3.5					
20.28440	35 49 39.6		6.2					
.29640		5 51 43.3		6.7				
25.30387	42 49 19.5		25.5					
.33375		7 18 33.9		46.5				
26.31923	44 19 56.1		26.5					
.32055		7 36 3.4		+17.5				
Mar. 1.35603	49 3 33.7		23.0					
.35607		8 32 40.0		— 5.3				
4.33246	54 0 38.7	9 30 21.7	27.3	+ 4.0	9	2.5	—0.7	Cp., G.
5.33868	55 45 22.3		39.9		11	+1.6	0.0	"
.36374		9 50 11.4		—10.4	12	—1.8	—3.1	"
6.33407	57 31 29.1		36.6					
.33984		10 9 18.4		1.2				
7.31281	59 18 3.0		31.8					
.32804		10 28 17.0		8.4				
8.33049	61 10 40.3		55.0					
.33238		10 47 27.7		—11.7				
9.31552	63 2 25.8		44.4					
.31715		11 7 9.0		+53.1				
10.32295	64 58 43.3		45.7					
.33783		11 25 11.5		— 1.3				
11.31920	66 55 45.6		52.2					
.34304		11 43 23.8		— 2.9				
12.32438	68 56 2.7		50.1					
.33595		12 0 59.2		+ 2.2				
13.31428	70 56 20.2	12 17 37.6	53.2	0.0				
14.33009	73 1 30.1	12 34 20.4	64.4	+ 5.3	30		+0.4	Cp., W.
15.31666		12 49 26.1		—12.1				
.32231	75 5 49.6		52.4					
17.32218	79 20 17.8		56.9		33	+0.7	+1.0	Cp., M., W.
.32259		13 18 18.2		+ 1.1				
18.31748	81 28 41.4		62.6					
.32364		13 31 6.7		— 0.1				
19.30452	83 37 4.6	13 42 37.8	59.5	— 0.5				
20.32705	85 50 38.7	13 53 35.6	65.2	+ 5.3				
21.34050		14 3 5.9		2.0				
.34112	88 3 46.3		59.3					
23.32339	92 23 55.9	—14 18 18.5	+73.2	+ 8.5				

Date. M. T. Greenwich.	α	δ	C. — O.		Star.	$d\alpha$	$d\delta$	Authority.
			$\Delta\alpha$	$\Delta\delta$				
d.	° ′ ″	° ′ ″	″	″		″	″	
1846, Mar. 24.34993	94 38 28.9		+69.9					
.35312		—14 24 4.0		— 1.3				
26.32241	98 54 54.1		74.9					
27.31010	101 6 2.7		56.9		47	—1.2	—1.6	Cp., G., V.
.34780		14 33 54.0		1.3				
28.34233		14 34 49.5		— 0.2				
.34308	103 13 29.4		68.8					
29.34362	105 19 6.9	14 34 39.1	80.5	+ 1.2	52	2.7	+0.5	Cp., G.
31.31654	109 26 2.7		57.7		54	—1.0	+2.2	Cp., V.
.34938		14 30 59.4		— 5.6				
April 2.31655	113 20 33.6		56.1					
.33819		14 23 46.0		— 4.1				
3.30528	115 15 6.7		+45.0					
.31047		—14 19 13.4		+ 6.8				

March 28. 1st line, *for* 51m., *read* 52m..

GENEVA. (*Astr. Nachr.*, XXIV. p. 59; XXV. p. 117.)

Date. M. T. Greenwich.	α	δ	C. — O.		Apparent Places of Stars.		Authority.
			$\Delta\alpha$	$\Delta\delta$	α	δ	
d.	° ′ ″	° ′ ″	″	″	° ′ ″	° ′ ″	
1845, Dec. 26.24166	347 25 15.8	+0 36 26.2	—19.9	+ 3.7	346 56 30.0	+0 28 21.9	C., H.
27.26361	347 57 56.3	0 32 17.7	13.5	— 0.5	29.9	21.8	"
29.23389	349 2 52.0	0 24 29.2	4.0	+ 0.4	319 45 38.8	0 24 53.7	C., G., H.
31.26815	350 12 48.4	+0 16 57.6	11.3	— 8.4	350 30 48.4	+0 19 2.4	C.
1846, Feb. 3.29761	16 31 16.6	—2 24 28.4	— 7.4	+12.2	15 50 27.8	—2 5 43.4	H., M.
5.28232	18 30 15.5	2 42 45.0	+ 2.0	53.8	18 29 35.5	2 48 22.5	H., W.
10.27001	23 46 43.5	3 33 30.5	—15.0	5.8	23 14 28.9	3 24 10.1	G., H., W.
11.28690	24 54 11.4	3 45 26.6	3.0	+ 9.2	24 56 10.1	3 41 0.8	H., W.
12.29714	26 2 47.2	3 57 33.4	15.6	— 0.7	24 49 1.8	3 53 14.5	Weisse I. 715.
17.28521	31 58 49.9	5 5 13.7	— 2.7	+ 1.3	32 59 19.6	5 3 31.0	Cp.
18.28218	33 13 57.7	5 20 12.2	+ 5.5	5.1	19.4	31.0	"
19.28101	34 30 51.7	5 35 31.3	5.4	0.8	35 41 21.2	5 43 15.8	"
20.28900	35 49 56.4	5 51 33.2	11.3	+ 3.7	21.0	15.9	"
26.30275	44 18 41.9	7 35 24.1	11.4	— 2.1	43 0 39.0	7 47 52.5	Weisse II. 920.
Mar. 3.32257	52 17 37.0	9 10 36.0	27.5	— 4.1	52 50 48.6	9 0 56.9	Weisse III. 593.
13.33164	70 58 54.1	12 18 4.4	49.0	+ 6.4	71 7 48.6	12 13 0.8	Cp.
16.33700	77 14 16.1	13 4 32.4	51.7	— 8.2	76 32 4.2	13 7 55.8	D.
21.31628	88 0 36.2	14 2 51.8	53.7	+ 0.8	87 21 9.6	14 12 19.4	G.
22.32509	90 13 7.1	14 11 5.7	55.4	— 4.3	90 32 25.2	14 2 59.0	Weisse VI. 44.
30.32846	107 21 48.9	—14 33 29.5	+49.3	+ 5.8	107 31 16.4	—14 35 1.0	H. W.

Feb. 5. But one comparison with star.

GREENWICH. (*Greenwich Observations*, 1845, pp. 126, 143.)

The observations at Greenwich, as given in the volume here quoted, exhibit some large discrepances, which are found chiefly to attach to the instrumental positions. Omitting these, therefore, I have reduced anew all the differential measurements, and obtained the following results: —

Date. M. T. Greenwich.	α	δ	C. — O.		Star.	$d\alpha$	$d\delta$	Authority.
			$\Delta\alpha$	$\Delta\delta$				
d.	° ′ ″	° ′ ″	″	″		s.	″	
1845, Dec. 23.27086		+0 49 12.6		+15.7	i_1		—109.6	G.
24.26479	316 23 25.2		— 0.2		"	—0.09		"
30.26131	349 37 51.1		7.4		$\varkappa$ Piscium	+0.07		C., G., H.
1846, Jan. 20.29004	4 2 49.9	—0 57 4.2	11.4	7.6	10 Ceti	+0.23	0.9	G., H., M.
31.26561	13 35 55.1		3.3		i_3	—0.06	2.1	G., H.
.26737		2 0 26.3		6.0				
Feb. 7.29981	20 35 21.1		—10.4		i_4	0.06	0.2	G.
.30292		3 1 42.0		16.2				
9.28918	22 42 11.2		+ 5.8		i_5	0.08	— 1.6	G., H., W.
.29127		—3 22 28.1		+ 2.6				

Date. M. T. Greenwich.	α	δ	C. — O. Δα	Δδ	Star.	dα	dδ	Authority.
1846, Feb. 28.29573 d.	47° 22′ 7″.2		+37″.8		i_6	—12.68 s		Weisse III. 178.
Mar. 2.34058	50 39 25.1		39.4		i_7	— 0.09		G.
5.33981	55 45 37.2		32.1		i_9	+ 0.11		Cp., G.
.33985		—9° 49′ 47″.0		—6″.9	i_9	0.00	— 0″.1	"
23.33372	92 25 15.0	14 18 12.0	75.5	—2.0	i_{10}	— 3.05	33.1	Cp.
24.32411		14 24 1.4		+5.1	i_{11}		— 0.4	G.
27.35058	101 6 39.9		(100.1)		i_{12}	0.44	+ 1.4	Cp., G., V.
.35074		14 33 59.2		3.8	i_{13}	0.45	— 0.5	Cp., G.
29.36309		—14 34 37.7		+0.6	i_{13}	— 0.45	— 0.5	"
.36510	105 22 21.3		+44.1					

In the original observations ; —

Jan. 20. Series 20. In R.A. of Comet, *for* 12.75, *read* 11.75.

March 29. Series 75. The Mic. reading for the comet is assumed 5 rev. in error.

HAMBURG. (*Astr. Nachr.*, XXIV. pp. 8, 27, 37, 64.)

Date. M. T. Greenwich.	α	δ	C. — O. Δα	Δδ
1846, Jan. 27.22452 d	9° 54′ 19″.3		—14″.8	
.22557		—1° 33′ 23″.7		+ 7″.7
Feb. 2.23866	15 29 17.5	2 15 30.2	15.5	— 1.1
9.28061	22 41 52.4	3 22 28.7	8.8	+10.2
14.25153	28 18 38.1	4 22 42.1	—21.0	1.5
26.27305	44 15 42.2	7 34 53.8	+30.4	0.3
Mar. 21.34480	88 4 26.3	14 3 14.3	48.3	+ 8.2
22.35477	90 16 40.3	14 11 10.9	76.2	—12.7
23.31551	92 23 6.1	14 18 18.5	61.0	+11.6
24.30948	94 33 23.1	—14 22 47.0	+58.4	—64.8

Feb. 14. *Astr. Nachr.*, XXIV. p. 28. The " d. Begleiter " belongs to the first observation; and should be applied also to the observation of February 15.

HARTWELL. (*Monthly Notices*, VII. p. 82.)

As these observations appeared to be only approximate, I compared them immediately with the ephemeris, without computing the parallax.

Date. M. T. Greenwich.	α	δ	C. — O. Δα	Δδ
1846, Feb. 28.32528 d.	47° 23′ 30″	—8° 14′ 10″	+122″	+61″
Mar. 2.33744	50 36 0	8 52 20	+226	43
5.29846	55 48 4	9 49 17	—376	+11
10.34372	65 8 0	11 24 33	366	—16
20.38303	86 6 15	13 53 30	431	34
22.37738	90 31 15	—14 10 14	—620	—80

KÖNIGSBERG. (*Königsberg Observations*, XXIX. p. 106.)

Date. M. T. Greenwich	α	δ	C. — O. Δα	Δδ		dα	dδ	Authority.
1846, Jan. 14 22928 d.	359° 23′ 43″.5	—0° 32′ 16″.9	—14″.8	+ 2″.3		—0″.3	+1″.0	C., K.
15.22666	0 7 55.7	0 36 6.8	13.7	6.5		"	"	"
17.23369	1 38 58.0	0 44 1.1	14.9	7.6				
26.22939	9 1 36.3	1 27 32.8	10.4	12.3		1.6	1.1	C., H., K., W.
27.24986	9 55 37.9	1 33 35.2	12.5	10.3				
28.24065	10 48 47.5	1 39 45.5	10.4	10.0		1.6	1.0	C., G., K.
29.24892	11 43 46.9	1 46 18.3	14.3	7.5		"	"	"
Feb. 14.30053	28 21 52.0	4 23 35.0	— 7.0	+15.2		—1.3	+1.6	H., K., W.
Mar. 11.26928	66 49 54.6	—11 42 6.8	+48.2	— 0.8				

KREMSMÜNSTER. (*Astr. Nachr.*, XXV. p. 279.)

Date. M. T. Greenwich.	α	δ	C. — O.	
			Δα	Δδ
d	° ′ ″	° ′ ″	″	″
1845, Dec. 22.24682	345 23 6.3	+0 53 12.3	+ 5.7	+61.0
26.30926	347 27 15.8	0 35 13.4	—11.0	+59.6
29.30891	349 5 22.0	0 24 19.2	— 2.4	— 7.0
31.31989	350 13 44.8	+0 16 12.2	+40.3	+25.6
1846, Jan. 12.22639	357 57 41.9	—0 23 47.0	—61.3	—69.7
Feb. 1.23603	14 30 57.9	2 7 48.2	+ 9.0	+10.7
10.24808	23 44 53.1	3 33 14.0	+ 8.5	+ 4.4
12.24045	25 58 49.1	3 56 35.5	— 9.7	—16.5
19.25416	34 28 1.6	5 35 58.2	+50.3	+52.9
21.25627	37 7 41.6	6 7 22.1	— 2.5	7.5
22.30557	38 32 29.8	6 26 2.2	+61.6	75.5
24.27073	41 19 29.9	6 59 3.2	5.0	15.5
27.26988	45 46 42.7	7 53 32.7	22.8	12.8
Mar. 1.27542	48 56 4.9	8 31 22.0	+ 5.2	+ 9.2
2.27102	50 33 13.6	8 49 43.8	— 0.8	—35.9
3.26290	52 11 52.1	9 9 43.8	+11.4	+13.1
4.27980	53 55 0.7	9 29 9.8	39.6	— 6.5
7.28756	59 15 19.2	10 27 15.4	29.1	—23.3
12.27360	68 49 58.2	12 0 16.0	47.3	+24.0
13.31198	70 56 9.9	12 17 20.1	46.7	—15.2
16.27541	77 6 17.1	13 3 38.1	63.3	9.7
20.32996	85 51 15.9	13 53 29.8	50.8	— 2.2
22.33220	90 13 48.6	14 11 33.5	70.0	+20.2
23.31534	92 21 57.6	14 19 2.4	128.2	55.5
24.32738	94 35 54.4	14 23 57.6	47.5	0.3
27.32611	101 4 9.2	14 34 27.1	62.9	34.0
30.32025	107 20 36.2	14 34 32.0	61.3	67.4
April 13.32030	132 14 16.1	—13 2 58.0	+ 8.8	+33.9

LEYDEN. (*Astr. Nachr.*, XXIV. p. 207.)

Date. M. T. Greenwich.	α	δ	C. — O.		dα	dδ	Authority.
			Δα	Δδ			
1846, March 27.37039	101° 9′ 12″.0	—14° 33′ 58″.2	+100″.0	+1″.1	—1″.5	—4″.9	C., G., V.

LONDON. (*Astr. Nachr.*, XXIII. p. 412. *Regent's Park Observations*, p. 212.)

Date. M. T. Greenwich.	α	δ	C. — O.			Apparent Place of Star.		Authority.
			Δα	Δδ		α	δ	
d.	° ′ ″	° ′ ″	″	″				
1845, Dec. 19.28500	343 59 49.8	+1 8 40.3	—18.3	+10.0		Instrumental	Position.	
20.28145	344 26 46.8	+1 3 38.3	+16.2	7.9		"	"	
1846, Feb. 8.30355	21 38 47.5	—3 11 54.7	+ 0.6	+ 8.2		21° 49′ 21″.3	—3° 7′ 36″.2	Weisse I. 478.

MARKREE. (*Astr. Nachr.*, XXIV. p. 48.)

I have not computed the parallax for these observations.

Date. M. T. Greenwich.	α	δ	C. — O.	
			Δα	Δδ
d.	° ′ ″	° ′ ″	″	″
1846, Feb. 24.34718	41 24 52.8	—6 58 57.0	+78.3	—71.9
25.33235	42 51 42.0		+33.8	
.33548		—7 18 55.0		+65.7

(*To be continued.*)

OBSERVATIONS OF FORTUNA,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

BY MR. JAMES FERGUSON.

[Communicated by Lieutenant MAURY.]

[Corrected for refraction.]

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑲ — *		⑲'s apparent		A.
				$\Delta\alpha$	$\Delta\delta$	α	δ	
1852.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
Sept. 13	8 37 11.4	1	Weisse XXII. 13	+2 18.65	— 1 34.25	22 4 1.50	—9 32 49.31	8
	10 8 14.2	6	"	+2 15.66	— 1 51.43	3 58.51	33 6.49	8
16	9 19 40.9	10	"	+0 17.83	—15 56.89	2 0.67	47 12.03	10
	9 43 6.6	4	Weisse XXI. 1375	+2 31.54	+ 6 41.21	2 0.69	47 13.42	10
17	9 8 18.5	10	"	+1 55.55	+ 2 17.44	1 24.69	51 37.02	10
18	9 19 30.1	8	"	+1 19.82	— 2 8.35	22 0 48.96	9 56 2.82	10
22	8 20 23.4	10	"	—0 43.78	—18 23.32	21 58 45.34	10 12 17.90	10
26	8 19 28.5	23	Weisse XXI. 1333	—0 36.29	+10 42.53	57 7.74	25 48.65	10
27	8 33 53.8	10	"	—0 56.28	+ 7 36.01	56 47.74	28 55.21	10
28	7 54 9.9	10	"	—1 13.71	+ 4 47.23	56 30.30	31 44.01	10
29	8 1 38.5	10	"	—1 30.22	+ 2 1.08	56 13.78	34 30.17	10
30	7 44 51.4	10	"	—1 44.09	— 0 33.47	55 59.91	37 3.74	10
Oct. 1	9 6 51.6	5	"	—1 57.10	— 3 6.22	55 46.89	39 37.61	9
2	8 53 42.7	7	"	—2 7.11	— 5 19.43	55 37.10	41 50.04	9
5	9 53 23.7	6	"	—2 26.59	—11 5.80	55 17.36	47 37.32	10
7	9 41 34.5	6	"	—2 29.55	—13 59.99	55 14.38	50 31.62	10
8	9 28 41.1	6	"	—2 28.24	—15 11.71	55 15.68	51 43.38	10
11	8 44 49.9	6	"	—2 12.19	—17 45.81	55 31.73	54 17.64	10
15	8 27 24.1	6	"	—1 24.04	—18 44.70	56 19.83	55 16.72	9
16	8 7 21.6	4	"	—1 7.42	—18 32.95	56 36.41	55 5.03	9
19	10 3 27.7	6	"	—0 3.91	—16 53.04	57 39.88	53 25.28	10
20	8 52 35.6	3	"	+0 19.80	—16 4.39	58 3.59	52 36.71	10
21	9 9 34.7	4	"	+0 46.36	—15 8.14	58 30.13	51 40.52	10
		4	Weisse XXI. 1384	—1 25.79	— 3 48.20	58 30.21	51 32.60	10
23	8 19 8.1	10	"	—0 28.83	— 1 11.84	59 27.15	48 56.36	10
24	9 9 37.3	10	"	+0 3.91	+ 0 27.38	21 59 59.87	10 47 16.60	10
25	8 29 7.6	4	"	+0 36.06	+ 2 9.42	22 0 32.00	10 45 34.61	10
Nov. 21	7 42 17.4	3	Weisse XXII. 467	+2 44.53	+11 27.65	24 55.62	8 58 40.41	10
	9 37 3.7	4	"	+2 50.40	+12 0.37	25 1.50	58 7.70	10
27	7 4 9.1	12	Weisse XXII. 641	+1 45.24	+18 45.02	32 22.92	21 1.01	10
	7 6 23.9	11	" 675	+0 35.73	+ 1 15.07	32 22.94	20 58.58	10
28	7 10 45.2	8	" 675	+1 54.56	+ 7 58.39	33 41.75	14 16.15	10
30	7 54 21.4	13	" 761	+0 52.69	— 0 54.42	36 22.99	8 0 4.47	10
	9 23 56.1	3	" 761	+0 57.28	— 0 26.73	36 27.58	7 59 36.78	10
Dec. 1	7 25 23.4	5	" 761	+2 12.17	+ 6 6.29	37 42.50	53 3.83	10
5	7 41 7.0	1	" 900	+0 27.09	+18 7.28	43 17.79	23 11.35	10
	8 40 40.8	3	" 900	+0 29.29	+18 26.51	43 19.99	7 22 52.12	10
8	7 7 57.5	10	" 962	+1 34.81	— 6 20.84	47 32.86	6 59 52.01	8
13	6 47 14.0	4	" 1049	+4 27.63	+ 9 47.88	54 57.05	18 36.63	9
(1)		4	" 1057	+4 0.95	+ 9 3.59	(22 54 58.07)	6 18 35.32	9
18	6 28 31.4	4	" 1272	+2 26.62	+ 0 3.47	23 2 44.14	5 34 18.94	10
		4	" 1283	+1 42.30	+ 0 14.72	2 43.94	34 22.23	10
	8 21 58.9	1	" 1272	+2 29.74	+ 0 22.75	2 47.25	33 59.67	10
		1	" 1283	+1 45.59	+ 0 33.99	23 2 47.23	—5 34 2.96	10

(1) The determination by 1049 to be preferred.

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XXII. 13	8	22 1 34.13	—9 32 3.20	Weisse's Catalogue.
Weisse XXI. 1375	9	21 59 20.43	9 54 42.24	"
" 1333	9	21 57 35.34	10 37 18.39	"
" 1384	9	21 59 47.56	10 48 30.01	"
Weisse XXII. 467	8	22 2 3.03	9 10 55.11	"
" 641	9	22 30 29.68	8 40 33.56	Weisse and Rümker.
" 675	9	22 31 39.21	8 23 1.33	"
" 761	8	22 35 22.36	7 59 58.02	Weisse's Catalogue.
" 900	8.9	22 42 42.76	7 42 6.93	"
" 962	9	22 45 50.15	6 54 19.76	Weisse and Rümker.
" 1049	8.9	22 50 21.57	6 29 13.20	Weisse's Catalogue.
" 1057	8.9	22 50 49.26	6 28 27.40	"
" 1272	9	23 0 9.68	5 35 11.67	"
" 1283	9	23 0 53.80	—5 35 26.25	"

FROM A LETTER OF PROFESSOR PETERSEN TO THE EDITOR.

Altona, 1853, *March* 22.

The comet which Dr. Hartwig discovered on the 10th of March had already been discovered on the 6th, at 8h. 15m. M. T., in the constellation *Lepus*, by Professor Secchi, at the Observatory of the Collegio Romano; and on the 8th, at 8h. 45m. M. T., in about 73° R.A. and 11° 40′ south declination, by Professor Schweizer, at Moscow. Both of these observers, as well as Dr. Hartwig, describe the comet as quite large and bright. Professor Secchi estimates the diameter at 5′, and a brighter part with a small nucleus at 3′. In the observations given below, the nucleus was observed with a ring-micrometer; it was, however, not very distinct, and Professor Secchi believes that he sometimes even saw several bright points in the denser part of the comet. Professor Schweizer gives the diameter about 8′, and says that no tail was visible, so far as could be determined in the mists near the horizon.

OBSERVATIONS. FIRST COMET OF 1853.

1. At the Observatory of the Collegio Romano at Rome.

1853.	M. T. Rome.	☄ α	☄ δ	Comp.
	h. m. s.	s. h. m. s.	′ ″ ° ′ ″	
March 6	8 55 42	a + 7.01 = 4 52 45.78	a + 8 14.2 = —15 50 47.2	3
	9 43 51	a + 1.07 = 4 52 39.84	a +13 29.7 = —15 45 41.7	3
7	7 18 54	f —10.30	f + 1 16.9	5
	8 39 25	f —17.31	f + 9 1.7	5

In the reductions, refraction is not taken account of.

By comparisons of the star *a* (9 mag.) with H. C. 9420, and of the star *f* with H. C. 9460 and Weisse IV. 1202, Professor Secchi finds,

	* α	* δ
	h. m. s.	° ′ ″
Apparent place of *a*	4 52 38.77	—15 59 1.38
Mean place of *f* for 1853.0	4 50 41.90	—13 40 36.4

2. At the Vienna Observatory.

1853.	M. T. Vienna.	☄ App. α	Log. F. P.	☄ App. δ	Log. F. P.	No. of Comp.	Observer.
	h. m. s.	h. m. s.		° ′ ″			
March 16	7 52 12.7	4 38 4.59	8.480	+0 0 24.0	9.873	6	Hornstein.

Mean Places of Comparison-Stars for 1853.0.

* α	* δ	
h. m. s.	° ′ ″	
4 37 10.55	+0 17 36.1	Lalande 8934 and B. Z. 39
4 40 10.64	—0 21 9.6	Lalande 9021.

3. At the Königsberg Observatory, by Professor Peters.

1853.	M. T. Königsberg. h. m. s.	☄ App. α	☄ App. δ	Comparison-Star.
March 19	9 33 6	68° 59′ 43″	+2° 46′ 44″	Weisse IV. 754.

The sky soon becoming clouded, only one observation could be made with the lowest power.

ELEMENTS AND EPHEMERIS BY MR. BRUHNS.

T	1853, Feb. 23.797188 M. T. Berlin.	
π	153° 8′ 0″.4	Mean Equinox, 1853.0.
☊	73 36 0.4	
i	21 35 7.6	
Log. q	0.042740	
	Motion Retrograde.	

These elements were computed from the following Berlin observations :—

1853.	M. T. Berlin. h. m. s.	☄ α	☄ δ	No. of Comp.	*
March 11	8 15 4.9	70° 49′ 50″.6	—6° 11′ 9″.7	10	*a*
12	8 31 2.4	70 30 11.4	4 42 44.6	10	*b*
13	8 8 38.6	70 12 57.0	—3 23 29.1	11	*c*

Adopted Mean Places of Comparison-Stars for 1853.0.

	* α	* δ	
a	70° 24′ 43″.3	—6° 6′ 33″.8	B. Z. 211, and Lalande 9061
b	69 8 17.0	4 34 41.5	B. Z. 140
c	71 2 7.6	—3 23 39.3	B. Z. 140, and Lalande 9135

With B. Z. 140, the reduction table which Weisse gives in the preface to his catalogue was used. According to Bessel's reduction table, the star *c* differs over 20 seconds in right ascension from Lalande ; this, therefore, seems to be incorrect.

Ephemeris for 0ʰ· *Berlin Mean Time.*

1853.	☄ α h. m. s.	☄ δ	Log. △
March 15	4 39 12	—1° 28′	9.9518
16	38 18	—0 12	
17	37 31	+0 42	
18	36 48	1 40	
19	36 10	2 33	0.0136
20	35 35	3 23	
21	35 4	4 9	
22	34 35	4 53	
23	34 9	5 33	0.0678
24	33 46	6 11	
25	33 26	6 48	
26	33 8	7 23	
27	32 52	7 56	0.1155
28	32 38	8 27	
29	4 32 27	+8 57	
March 30	4 32 17	+9° 26′	
31	32 8	9 53	0.1576
April 1	32 1	10 19	
2	31 55	10 43	
3	31 50	11 6	
4	31 46	11 29	0.1951
5	31 44	11 51	
6	31 43	12 12	
7	31 43	12 32	
8	31 44	12 52	0.2288
9	31 46	13 11	
10	31 50	13 29	
11	31 55	13 47	
12	4 32 2	+14 4	0.2595

In the same letter in which Professor Secchi announces his discovery, he writes me :— "On the same evening (March 6), a very faint double nebula was found in the constellation *Leo*. It follows the star γ 3ᵐ· 34ˢ·, and is about 3′ farther north. It is not in the catalogue of Herschel. The two centers are 3ˢ· apart in R.A., and about 3′ in declination."

A. C. PETERSEN.

FROM A LETTER OF MR. W. C. BOND TO THE EDITOR.

FIRST COMET OF 1853.

Harvard Observatory, 1853, *April* 13.

1853.	M. S. T. Cambridge.	☄ − * $\Delta\alpha$	☄ − * $\Delta\delta$
	h. m. s.	m. s.	
March 29	8 10 22	+4 13.67	+3′ 36″

☄'s App. α	☄'s App. δ
h. m. s.	
4 32 25.47	+8° 57′ 45″.3

by 4 comparisons in R.A. and 2 in Dec.

Star of comparison, Weisse, H. IV. No. 602.

App. α 4h. 28m. 11s..8 δ +8° 54′ 9″.3.

Elements by C. W. Tuttle *from the Cambridge Observations of March* 10, 18, *and* 29.

T	1853, Feb. 24.165622 M. T. Greenwich.	
π	153° 37′ 58″	Apparent Equinox, 1853, March 18.
☊	69 15 30	
i	20 8 11	
Log. q	0.037938	
	Motion Retrograde.	

Ephemeris for Greenwich Mean Midnight, by C. W. Tuttle, *Second Assistant at this Observatory.*

1853.	☄ α	☄ δ	Log $\triangle$
	h. m. s.	° ′	
April 14.5	4 32 14	+14 12.7	0.27321
15.5	32 22	26.9	
16.5	32 30	40.8	
17.5	32 39	14 54.3	
18.5	4 32 48	+15 7.5	0.29889
April 19.5	4 32 58	+15 20.3	
20.5	33 9	32.8	
21.5	33 20	45.0	
22.5	33 32	15 56.8	0.32202
23.5	33 44	16 8.4	
24.5	33 56	19.6	
25.5	34 9	30.5	
26.5	34 23	41.2	0.34291
27.5	34 37	16 51.7	
28.5	34 51	17 1.9	
29.5	35 5	11.8	
30.5	35 21	21.6	0.36184
May 1.5	35 36	31.2	
2.5	35 52	40.6	
3.5	36 7	49.8	
4.5	4 36 24	+17 58.9	0.37891

Elements, calculated by J. D. Runkle, *from the Cambridge Observations of March* 10, 14, *and* 18.

T	1853, Feb. 23.81885 M. T. Cambridge.	
π	153° 29′ 50″	Apparent Equinox, 1853, March 14.
☊	70 24 11	
i	20 30 24	
Log. q	0.03932	
	Motion Retrograde.	

W. C. BOND.

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From a Letter of Mr. W. C. Bond to the Editor.

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ON THE ORBIT OF BIELA'S COMET IN 1845-46.

BY PROFESSOR J. S. HUBBARD,

OF THE WASHINGTON OBSERVATORY.

(*Continued from page* 68.)

MARSEILLES. (*Astr. Nachr.*, XXIV. p. 9.)

Date. M. T. Greenwich.	α	δ	C. — O.		Mean Places, 1846.0, of Stars of Comparison.			
			$\varDelta\alpha$	$\varDelta\delta$	Star.	α	δ	Authority.
d.	° ′ ″	° ′ ″	″	″		° ′ ″	° ′ ″	
1845, Dec. 24.28311	346 24 9.2	+0 43 48.1	—10.1	+67.2	H. C., p. 119	346 23 19.5	+0 5 23.4	Lalande 45439.
25.24940	346 53 52.9	0 40 33.1	8.3	9.2	P. XXIII. 21	346 55 39.3	0 27 54.5	H.
26.24596	347 25 7.6	0 36 25.5	3.4	3.3	$\varkappa^1$ Piscium	349 44 49.7	0 24 29.0	G., H., P.
27.25986	347 57 45.6	0 32 18.0	10.1	+ 0.1	$\varkappa^2$ "	349 49 35.7	+0 16 19.1	G.
28.26127	348 30 22.4	0 28 43.8	0.8	—26.3				
29.28768	349 4 45.9	0 24 51.6	— 9.2	34.5				
30.30646	349 38 46.4	0 22 3.0	+30.2	—98.8				
31.27246	350 13 0.1	0 16 48.0	—14.6	+ 0.3				
1846, Jan. 1.30652	350 49 38.6	+0 13 10.4	—22.8	— 8.5				

Jan. 1. First observation of R.A., *for* 1′ 4″, *read* 1° 4′ 0″.

NAPLES. (*Astr. Nachr.*, XXIV. p. 249.)

Date. M. T. Greenwich.	α	δ	C. — O.	
			$\varDelta\alpha$	$\varDelta\delta$
d.	° ′ ″	° ′ ″	″	″
1845, Dec. 15.22102	324 14 41.6	+1 30 39.8	—51.4	+ 35.5
25.29741	346 55 44.1	0 40 48.4	29.8	— 18.4
26.25320	347 25 25.7	0 37 22.4	— 7.8	55.4
30.23142	349 36 26.2	+0 20 41.4	+15.9	0.3
1846, Jan. 14.22234	359 23 18.7	—0 32 3.8	— 8.4	— 9.2
19.23511	3 12 13.4	0 52 17.2	+ 0.4	+ 0.6
27.23771	9 55 12.9	1 32 57.1	—26.3	— 23.4
30.27349	12 40 7.8	1 53 28.9	+ 3.8	+ 17.0
31.23590	13 34 0.1	2 0 9.5	11.1	3.0
Feb. 3.23891	16 27 40.5	2 24 3.5	0.6	17.0
7.23907	20 31 3.3	3 0 52.4	+18.3	5.4
9.24500	22 39 27.7	3 22 16.0	— 2.7	21.1
19.25340	34 28 43.2	5 35 34.8	+ 5.1	30.2
21.26194	37 7 39.6	6 7 27.9	27.0	+ 7.6
22.31713	38 23 8.2	6 24 52.6	680.6	— 5.8
23.28668	39 55 1.4	6 41 10.5	31.8	— 24.0
26.25847	44 14 30.0	7 34 40.4	23.8	+ 3.0
27.28387	45 47 42.8	7 53 41.7	40.1	6.0
Mar. 4.26598	53 53 49.0	9 29 6.8	25.9	+ 6.6
12.28063	68 49 43.9	11 59 59.1	112.4	— 0.4
13.26921	70 50 57.2	12 17 6.0	45.3	+ 13.7
18.26673	81 21 56.9	13 30 33.2	72.7	8.4
25.29792	96 42 28.6	14 28 33.2	50.8	11.3
30.34677	107 24 10.9	14 33 52.9	42.4	31.2
April 13.33023	132 14 12.1	13 2 33.1	65.7	14.5
14.31688	133 40 23.2	12 53 27.9	+79.7	+ 6.4
19.39482	140 31 8.2	—12 5 39.9	—42.8	—106.2

March 25. The assumed place of the star of comparison, and the resulting α of the comet, are $1^{m\cdot}$ in error.

PADUA. (*Astr. Nachr.*, XXIV. p. 73.)

Date. M. T. Greenwich.	α	δ	C. — O. Δα	C. — O. Δδ
1845, Dec. 25.25208 d	316° 54′ 11″.6	+0° 40′ 35″.0	—22″.0	+ 6″.6
26.23720	317 25 11.7	0 36 37.0	24.2	— 6.0
27.23922	317 57 14.8	0 32 18.1	19.4	+ 5.1
31.32938	350 15 2.6	+0 16 53.1	17.6	—17.3
1846, Jan. 14.23163	359 24 2.2	—0 32 0.8	27.4	14.3
16.27714	0 55 36.1	0 39 4.7	36.1	59.8
24.26299	7 20 16.9	1 15 46.6	39.1	37.5
30.22856	12 38 34.2	1 52 33.7	52.7	—19.3
31.23893	13 34 49.4	2 0 32.4	28.0	+24.6
Feb. 3.26406	16 29 14.8	—2 24 2.2	— 4.6	+ 3.0

Jan. 30. I have assumed an error of 13′ in δ, as SANTINI's comparisons with his elements contradict the given value, which is 39′.

PARIS. (*Comptes Rendus*, XXII. pp. 287, 288.)

Date. M. T. Greenwich.	α	δ	C. — O. Δα	C. — O. Δδ	Assumed Apparent Places of Stars. α	Assumed Apparent Places of Stars. δ	Authority.
1846, Feb. 6.31533 d.	19° 34′ 9″.4	—2° 51′ 44″.6	—24″.5	+ 6″.0	20° 2′ 53″.1	—2° 50′ 8″.2	G.
10.30293	23 48 49.9	3 34 3.4	11.0	16.0	23 14 28.9	—3 24 11.3	G., H., W.
12.29990	26 3 2.1	—3 57 40.9	—19.2	+ 4.6			

PHILADELPHIA. (MS. Communication from Professor KENDALL.)

Date. M. T. Greenwich.	α	δ	C. — O. Δα	C. — O. Δδ	Assumed Apparent Places of Stars. α	Assumed Apparent Places of Stars. δ	Authority.
1846, Jan. 19.54646 d.	3° 27′ 8″.2	—0° 53′ 46″.8	— 6″.6	+ 8″.7	0h 18m 44s.05	—0° 51′ 10″.1	G., M., H.
22.56032	5 54 0.1	1 7 51.4	11.7	11.4	0 21 58.09	1 10 24.3	W.
21.51787	7 32 51.7	1 17 56.2	11.8	10.3	0 30 12.75	1 21 3.9	W.
28.50208	11 2 53.8	—1 41 32.9	— 6.9	+16.7	0 38 41.87	—1 40 42.5	W.

In *Astr. Nachr.*, XXIV. p. 195, are given the uncorrected differences of α and δ between the comet and unknown stars, as observed at Prague. As these data depend on only a few comparisons with the ring-micrometer, and are for times when other observations occur most frequently, I have not undertaken to identify the stars and reduce the observations.

ROME. (*Astr. Nachr.*, XXIII. p. 389.)

Date. M. T. Greenwich.	α	δ	C. — O. Δα	C. — O. Δδ	Assumed Apparent Places of Stars. α	Assumed Apparent Places of Stars. δ	Authority.
1845, Nov. 28.28688 d.	336° 50′ 59″.6	+3° 38′ 52″.8	—75″.7	+109″.8	334° 41′ 49″.2	+3° 36′ 46″.3	P.
					335 32 48.9	3 39 15.9	D. P.
29.29650	337 2 45.0	3 32 29.8	+51.1	— 80.0	336 40 56.4	3 25 54.2	D.
Dec. 1.26389	337 32 27.6	+3 14 16.9	+12.6	— 61.1	336 48 10.0	+3 23 21.2	Weisse XXII. 578.

SENFTENBERG. (*Astr. Nachr.*, XXIV. p. 129.)

Date. M. T. Greenwich.	α	δ	C. — O. Δα	C. — O. Δδ
1846, Mar. 2.25878 d.	50° 31′ 10″.5	—8° 50′ 13″.6	+19″.9	+ 8″.0
4.25899	53 52 52.2	9 28 31.8	39.4	—20.2
5.30021	55 41 41.7	—9 48 35.5	+17.2	—32.2

STARFIELD. (*Monthly Notices*, VII. p. 76.)

Date. M. T. Greenwich.	α	δ	C. — O. Δα	C. — O. Δδ	Assumed Apparent Place of Star. α	Assumed Apparent Place of Star. δ	Authority.
1846, Mar. 2.34116	50° 40′ 10″.0	—8° 51′ 37″.5	+15″.7	—6″.9	49° 33′ 59″.0	—8° 45′ 35″.0	Weisse III. 325.

VIENNA. (*Vienna Observations*, XXXIII. Part IV. p. 106.)

Date.	M. T. Greenwich.	α	δ	C. — O. Δα	C. — O. Δδ	Star.	dα	dδ	Authority.
	d.	° ′ ″	° ′ ″	″	″		s.	″	
1845, Dec.	17.23369	343 5 7.2	+1 19 37.2	—15.7	+10.5				
1846, Jan.	28.26714	10 50 17.3	—1 39 57.6	—14.2	11.9				
Feb.	18.26792	33 12 49.3	5 19 57.0	+ 8.8	2.9	*c* . 1	+0.21	—1.9	Cp.
	21.25366	37 7 15.1	6 7 14.1	10.9	+ 2.1	*d*	—0.24	2.4	Cp., H.
	22.26021	38 29 30.5	6 23 59.0	15.8	— 1.7				
Mar.	5.26949	55 38 11.2	9 48 30.0	33.6	— 1.8	*g* . 1	0.32	—3.9	Cp., G.
						g . 2	—0.05	+0.3	Cp., W.
	20.27214	85 43 38.9	13 52 58.7	53.6	+ 1.6	*h* . 1	+0.04	—1.4	Cp.
	22.28776	90 8 8.5	14 10 57.6	59.8	+ 4.7	*i* . 1	+0.05	+4.3	W.
	24.29181	94 30 52.5	14 23 42.4	69.5	— 3.9	*k* . 1	—0.08	1.2	Cp., V.
	27.32941	101 4 36.5	14 33 50.6	60.9	— 2.9	*l* . 1	+0.01	+1.8	Cp., G., V.
	30.31233	107 19 50.3	14 33 33.1	48.6	+ 7.8	*m*	—0.15	—2.8	H. W.
	31.32132	109 23 7.6	—14 31 17.3	+49.5	+ 7.7	*n*	+0.02	+0.3	Cp., V.

Jan. 28. The designations I. and II. should be transposed.

WASHINGTON. (*Washington Observations*, II. pp. 317, 332.)

Date.	M. T. Greenwich.	α	δ	C. — O. Δα	C. — O. Δδ	Star.	dα	dδ	Authority.
	d.	° ′ ″	° ′ ″	″	″		s.	″	
1846, Jan.	12.52936	358 9 38.5	—0 26 6.3	— 0.3	+ 4.5	*a*	+ 0.01	—1.0	H., W.
	13.47844	358 50 41.4	0 29 32.2	6.9	+ 3.9	“	“	“	“
	14.49645	359 35 15.8	0 33 5.3	0.3	— 9.2	*c*	— 0.08	1.4	H., W.
	18.50673	2 38 5.7	0 49 23.1	—13.2	+13.7	*h*	+ 0.11	0.6	H., W.
	19.48593	3 24 5.7	0 53 28.1	+ 3.0	5.9	“	“	“	“
	22.50317	5 51 11.2	1 7 30.7	—13.5	7.7	*j*	0.06	0.1	W.
	23.50222	6 41 8.4	1 12 27.4	7.2	2.3	*o*	0.56	2.0	H., W.
	24.51659	7 32 46.4	1 17 54.2	10.6	8.7	*q*	0.10	0.7	W.
	26.49639	9 15 33.4	1 29 2.6	4.5	8.3	*r*	0.15	0.7	C., H., K., W.
	28.49059	11 2 18.3	1 41 25.7	8.7	+14.0	*u*	+ 0.01	0.0	W.
Feb.	5.49456	18 43 20.2	2 43 42.1	— 5.3	— 7.6	b	— 0.44	1.7	H. W.
	9.49538	22 55 29.5	3 24 48.1	+12.1	+ 7.3	e	— 0.30	1.2	G., H., W.
	11.54733	25 11 29.1	3 48 35.5	10.3	10.8	f	+ 0.15	6.9	C., H., W.
	12.49877	26 16 16.6	4 0 18.1	2.5	13.5	i	+ 0.02	0.0	W.
	13.51246	27 26 18.9	4 13 14.4	5.0	16.1	j	— 0.03	0.8	C., H., K., W.
	16.49886	31 0 14.0	4 53 55.2	+11.6	8.9	k	— 0.22	—0.1	W.
	18.49904	33 30 37.7	5 23 34.9	— 0.5	9.7	q	+ 0.03	+0.4	Cp., W.
	21.52445	37 29 18.7	6 11 51.0	+ 6.5	10.1	r	— 0.23	—4.7	D., H., W.
	22.50391	38 49 42.2	6 28 16.5	16.0	7.9				
	26.51225	44 37 36.7	7 39 30.0	13.6	12.6	v	$2^{h}\ 55^{m}\ 53.88$	—7° 44′ 50″.9	Weisse II. 993.
Mar.	3.57823	52 43 19.8	9 15 44.8	36.7	6.9	w	+ 0.85	—2.5	H., W.
	4.58151	54 26 21.4	9 35 9.4	30.3	1.0	*β*	0.00	0.5	Cp.
	5.55872	56 8 55.1	9 54 13.4	22.2	4.0	*δ*	+ 0.01	0.0	W.
	8.55005	61 35 32.0	10 51 57.2	44.4	9.7	*ε*	— 0.01	0.7	Cp., W.
	10.57380	65 27 50.5	11 29 37.2	56.5	5.2	*θ*	— 0.06	0.2	Cp.
	14.55510	73 29 39.6	12 37 52.2	55.2	2.5	*ϰ*	+10.00	—0.5	Cp., W.
	17.57873	79 53 17.2	13 21 44.2	58.4	4.3	*λ*	+ 0.15	+0.1	Cp., M., W.
	21.57625	88 34 30.3	14 5 14.9	68.3	8.3	*ϱ*	— 0.02	—0.9	G., M., W.
	30.63989	107 59 35.7	14 33 2.3	78.0	14.5	*υ*	— 0.30	0.0	H., W.
	31.64012	110 1 28.4	14 30 33.8	60.5	19.3	*φ*	$7^{h.}\ 18^{m.}\ 5.86$	—14° 35′ 23″.7	Cp., V.
April	3.62067	115 50 50.3	14 17 42.2	60.5	+14.7	*χ*	+ 0.04	0.0	D.
	15.57578	135 27 42.1	12 41 40.2	51.3	—13.0	*ω*	— 0.01	+1.9	W.
	19.64467	140 48 13.4	—12 4 55.6	+50.7	—18.1	*A*	0.00	0.0	

March 3. Chron. times of transit of star w at first and second observation should be diminished $10^{s.}$.

March 31. Chron. times of transit of comet at second observation should be increased $5^{s.}$.

April 3. Diff. δ of stars shows mic. reading for χ to be $1^{r.}$ too great.

§ 3.

From the foregoing observations, I selected, as the material for the correction of the assumed elements, those made at Berlin, Cambridge, the Cape of Good Hope, Geneva, Greenwich, Königsberg, Philadelphia, Vienna, and Washington. And first, in order to remove the large residual of short period in R.A., which would render more difficult the accurate determination of normals, — as well as to obtain a better criterion for doubtful observations, especially at the beginning and end of the time of visibility when the comet was very faint and diffuse, — I computed from ten normals, based on nearly all the selected observations from December 17 to April 3 inclusive, the following new elements: —

ELEMENTS II.

M	0° 0′ 2″.65		
Ω_0	327 3 36.76	Ω	245° 54′ 4″.18
ω_0	139 36 51.62	ω	223 8 43.54
i_0	21 27 9.08	i	12 34 59.39
φ	49 11 7.59		
μ	536″.81267		

These elements give for the ten normals,

	$\Delta\alpha$	No. Obs.	$\Delta\delta$	No. Obs.
1845, Dec. 27	+2″.7	12	−4″.2	11
1846, Jan. 16	+0.7	11	−0.4	11
24	−1.2	18	+1.8	18
1846, Feb. 9	−1″.1	14	+0″.2	13
17	−4.0	14	+1.5	15
25	+0.6	18	+1.6	16
Mar. 5	+2.6	19	−0.1	16
13	+3.2	16	+0.5	16
21	+0.8	17	−0.5	18
29	−3.9	19	−0.9	20

In the mean time, the kindness of the observers at Washington enabled me to make the following corrections to the assumed places of the stars of comparison at the last dates of observation.

Date.	Place.	Star.	$d\alpha$	$d\delta$
April 13	Cambridge,	*kk*	+0ˢ.34	−9″.1
	"	*ll*	+0.14	−4.7
	"	*mm*	−0.55	−1.2
15	Washington,	ω	+0.31	+0.2
19	"	*A*	−0.09	−2.9
24	Berlin,	20	+0.06	−3.6

I have also received from Professor **CHALLIS** a small table of corrections to be applied to those stars in his list which he had not previously observed.

After applying the corresponding corrections to the places of the comet, I obtained for the whole series of selected observations the following residuals: —

Date.	C. — O. $\Delta\alpha$	$\Delta\delta$	Place of Observation.
1845, Nov. 28	(−12″.7) (1)	(+51″.4) (1)	Berlin.
29	+ 8.0	+13.0	Berlin.
Dec. 1	(+63.3)	−12.8	Cambridge.
2	+14.1	+ 7.7	Berlin.
3	(+58.4)	−15.7	Cambridge.
17	− 7.1	+ 7.5	Vienna.
19	+ 5.2	−14.2	Cambridge.
21	− 0.1	−10.8	Berlin.
23		+12.1	Greenwich.
	+ 9.8	− 4.3	Cambridge.
24	+ 8.7		Greenwich.
26	−10.8	0.0	Geneva.
27	− 4.4	− 4.4	Geneva.
29	+ 5.0	− 3.8	Geneva.
30	+ 1.7		Greenwich.
	+16.6	− 2.4	Cambridge.
31	− 2.1	−13.0	Geneva.
1846, Jan. 1	+ 5.6	−13.3	Cambridge.
12	+ 8.6	− 0.6	Washington.
13	+ 2.1	− 1.4	Washington.
14	− 6.0	− 3.1	Königsberg.
	+ 8.4	−14.7	Washington.
15	− 5.2	+ 0.9	Königsberg.
	− 0.5	− 0.5	Cambridge.
17	− 6.8	+ 1.6	Königsberg.
18	− 5.2	+ 7.6	Washington.
19	+10.6	− 0.3	Washington.
	+ 1.0	+ 2.5	Philadelphia.
1846, Jan. 20	−3″.9	+ 1″.3	Greenwich.
22	−6.4	+ 1.3	Washington.
	−4.6	+ 5.1	Philadelphia.
23	+1.7	− 2.9	Cambridge.
	−0.4	− 4.2	Washington.
24	+3.1	− 3.3	Cambridge.
	−4.1	+ 2.2	Washington.
	−5.4	+ 3.8	Philadelphia.
26	−4.1	+ 6.0	Königsberg.
	+1.7	+ 2.2	Washington.
27	−6.6	+ 4.0	Königsberg.
	−0.4	+ 0.4	Cambridge.
	−1.5	− 2.8	Berlin.
28	−4.7	+ 3.6	Königsberg.
	+2.4	− 4.7	Cambridge.
	−8.5	+ 5.6	Vienna.
	+8.9	+ 1.0	Berlin.
	−3.1	+ 7.7	Washington.
	−1.3	+10.4	Philadelphia.
29	−8.9	+ 1.3	Königsberg.
	+7.0	− 4.3	Cambridge.
31	+1.5	− 0.2	Greenwich.
Feb. 3	−4.0	+ 6.0	Geneva.
5	+4.4	(+47.8) (2)	Geneva.
	−3.1	−13.5	Washington.
6	−0.3	− 1.3	Berlin.
7	−9.1	+10.7	Greenwich.
9	+5.5	− 2.6	Greenwich.

(1) Single instrumental position.

(2) This observation is not retained by **PLANTAMOUR** in his discussions.

Date.	C. — O.		Place of Observation.	Date.	C. — O.		Place of Observation.
	$\Delta\alpha$	$\Delta\delta$			$\Delta\alpha$	$\Delta\delta$	
1846, Feb. 9	+11″.6	+ 2″.1	Washington.	1846, Mar. 10	+ 8″.7	— 2″.9	Cambridge.
10	—15.8	+ 0.7	Geneva.		+ 1.0	— 1.8	Cape.
11	— 4.4	+ 4.2	Geneva.		+ 3.4	+ 3.8	Washington.
	+ 8.3	— 7.3	Cambridge.	11	+ 1.7	— 0.3	Königsberg.
	+ 8.8	+ 5.8	Washington.		+ 5.6	— 2.5	Cape.
12	—17.8	— 5.6	Geneva.	12	— 2.9	— 3.0	Berlin.
		— 9.3	Cambridge.		+ 1.6	+ 2.6	Cape.
	+ 0.2	+ 8.6	Washington.	13	+ 2.6	+ 0.4	Cape.
13	+ 3.1	— 5.1	Cambridge.		— 1.5	+ 6.8	Geneva.
	+ 1.6	+11.4	Washington.	14	+11.9	+ 5.5	Cape.
14	—11.0	+10.7	Königsberg.		+ 2.5	+ 2.5	Washington.
16	+ 5.2	+ 4.9	Washington.	15	— 2.1	—12.3	Cape.
17	—10.2	— 2.7	Geneva.	16	— 1.5	— 8.7	Geneva.
18	— 0.9	+ 6.3	Berlin.	17	— 1.4	+ 0.3	Cape.
	+ 0.2	— 0.8	Vienna.		+ 0.4	+ 3.5	Washington.
	— 3.1	+ 1.4	Geneva.	18	+ 2.5	— 0.8	Cape.
	— 3.3	— 1.7	Cape.	19	— 2.1	— 1.7	Cape.
	— 9.3	+ 6.0	Washington.	20	— 8.9	+ 0.4	Vienna.
19	— 4.2	— 2.7	Geneva.		+ 2.7	+ 4.0	Cape.
	— 6.1	+ 3.3	Cape.		+ 2.3	+ 1.7	Berlin.
20	— 4.6	+ 3.5	Cape.		+ 1.4	— 0.1	Cambridge.
	+ 0.5	+ 0.6	Geneva.	21	— 3.6	— 2.3	Berlin.
21	— 1.0	— 0.9	Vienna.		— 9.1	— 0.8	Geneva.
	— 5.8	+ 7.2	Washington.		— 3.5	+ 0.3	Cape.
22	+ 2.5	— 4.3	Vienna.		+ 5.6	+ 6.2	Washington.
	+ 2.2	+ 5.3	Washington.	22	— 3.9	+ 2.4	Vienna.
24	+ 0.5	— 5.0	Berlin.		— 8.2	— 6.6	Geneva.
	+ 2.4	— 6.5	Cambridge.	23	+ 9.0	+ 5.7	Cape.
25	+ 7.3	(+45.1) (1)	Cape.		+11.3	— 4.9	Greenwich.
	+ 2.8	— 2.5	Cambridge.	24	+ 5.3	— 7.4	Vienna.
26	— 0.7	+ 5.6	Berlin.			+ 1.5	Greenwich.
	— 8.5	— 3.5	Geneva.		+ 4.4	— 2.9	Cambridge.
	+ 6.6	+16.2	Cape.		+ 5.1	— 4.9	Cape.
	— 6.7	+11.2	Washington.	25	+ 8.7	— 2.8	Cambridge.
27	+ 1.8	+ 1.5	Cambridge.	26	+10.0		Cape.
28	+14.6		Greenwich.	27	— 3.5	— 8.2	Vienna.
	— 3.6	+ 3.7	Cambridge.		(+35.7) (2)	— 1.6	Greenwich.
Mar. 1	— 4.2	— 6.1	Cape.		— 7.8	— 6.6	Cape.
2	— 6.9	(+76.7) (1)	Berlin.		(+30.2) (3)	(—21.4)	Cambridge.
	— 0.1	— 3.3	Cambridge.	28	+ 4.8	— 5.9	Cape.
	+12.4		Greenwich.	29	— 4.6	— 6.1	Cambridge.
3	— 1.3	— 4.3	Geneva.		+17.4	— 5.0	Cape.
	+ 7.3	+ 6.8	Washington.		—19.1	— 5.5	Greenwich.
4	+ 3.5	+ 1.6	Berlin.	30	—13.9	+ 1.1	Vienna.
	— 3.5	+ 4.3	Cape.		—13.3	— 0.8	Geneva.
	— 1.1	+ 1.3	Washington.		+15.9	+ 7.7	Washington.
5	+ 1.0	— 1.6	Vienna.	31	—12.0	+ 0.6	Vienna.
	+ 3.4	— 0.2	Cambridge.		— 3.7	—12.7	Cape.
	+ 7.1	—10.2	Cape.		— 0.4	+12.0	Washington.
	— 0.7	— 6.7	Greenwich.	April 1	—16.1	+13.5	Berlin.
	— 7.1	+ 4.4	Washington.		+11.7	+16.3	Cambridge.
6	+ 1.9	— 1.0	Cape.	2	— 2.6	—12.1	Cape.
7	— 5.6	— 8.2	Cape.	3	—12.3	— 1.5	Cape.
	+ 7.2	+10.5	Berlin.		+ 3.8	+ 6.3	Washington.
8	+15.2	—11.2	Cape.	13	— 8.3	—29.5	Cambridge.
	+ 4.1	+10.0	Washington.	15	+12.2	—22.1	Washington.
9	+ 2.5	(+53.4) (1)	Cape.	19	+23.4	—23.0	Washington.
10	+ 8.4	— 0.5	Berlin.	24	—22.3	—19.7	Berlin.

(1) Typographical errors of 1′ in Decl.? (2) But three badly agreeing comp. in R.A. (3) But one comp. in R.A. and two in Decl.

(To be continued.)

FROM LETTERS OF PROFESSOR PETERSEN TO THE EDITOR.

Altona, 1853, *April* 5.

The new comet was first seen, as far as is yet known, as you have doubtless long been aware, by Secchi in Rome on the 6th of March; but I am in hopes that it was sufficiently brilliant in the southern sky in February to have been long since found and observed at the Cape of Good Hope or in Madras. This is especially important if the comet be identical with that of 1664, and the elements of these two comets as at present computed are quite similar.

I am not in possession of much more information concerning the comet than I have already sent you. What little there is, I send you for such disposition as you think best, and some elements and an ephemeris by Marth in Königsberg.

OBSERVATIONS BY MR. G. RÜMKER AT THE HAMBURG OBSERVATORY.

1853.	M. T. Hamburg. h. m. s.	☄ α	Log. Coeff. Par.	☄ δ	Log. Coeff. Par.	No. Comp.
March 27	8 10 24	68° 13′ 4″.6	9.7151	+7° 53′ 47″.2	9.8771	10
28	8 11 56	68 9 59.2	9.7219	8 23 24.6	9.8719	7
30	8 9 35	68 4 44.4	9.7399	9 18 45.4	9.8761	12
31	8 25 21	68 2 34.3	9.7376	+9 44 11.6	9.8764	7

Apparent Places of the Comparison-Stars.

	✱ α h. m. s.	✱ δ
March 27	4 30 37.84	+7° 52′ 35″.4
	4 31 7.61	7 34 24.9
28	4 30 15.31	+8 23 42.5
30	4 30 56.77	+9 20 32.4
31	4 30 36.57	+9 53 32.3
	4 31 38.85	+9 35 39.9

ELEMENTS BY MR. MARTH.

T	1853, Feb. 23.99268	Greenwich M. T.
π	153° 44′ 51″.2	Mean Equinox of Perihelion.
☊	69 30 31.2	
i	20 13 43.8	
Log. q	0.038202	
" m	9.902824	
	Motion Retrograde.	

Ephemeris for Greenwich Mean Noon.

1853.	☄ α h. m. s.	☄ δ	Log △
April 20	4 33 13	+15° 28′.0	0.30820
21	4 33 24	+15 40.3	
April 22	4 33 35	+15° 52′.3	0.31961
23	33 47	16 4.0	
24	33 59	15.4	0.33046
25	34 12	26.5	
26	34 25	37.3	0.34077
27	34 39	47.9	
28	34 53	16 58.3	0.35058
29	35 8	17 8.5	
30	35 23	18.4	0.35991
May 1	35 38	28.1	
2	4 35 54	+17 37.7	0.36876

You will observe that this computation agrees almost absolutely with that of Mr. Bruhns in No. 853 *Astr. Nachr.*

1853, *April* 15.

I inclose Professor Schweizer's letter on the discovery of another comet at Moscow, on the 4th of this month.

On the 6th, Mr. Chacornac, at Marseilles, discovered a new planet, for which Professor Valz has proposed the name *Phocæa*, with the symbol ㉔. Professor Valz sends me, in his letter, the two following observations.

1853.	Marseilles M. T. h. m.	α m. s.	δ
April 6	15 40	a +4 11.5	a +11′ 2″
8	11 58	b +1 57	b + 4 22

The star a is H. C. Nos. 37363 and 37366. The star b is Argel. Zone 16, No. 205.

This is all that I can send in relation to this new planet to-day, as I received the news only an hour since.

1853, *April* 22.

Professor de Gasparis, on the evening of the 5th of this month, noticed, in the Constellation *Leo*, a small star of the 12 magnitude, which on the following evening he knew to be a planet by its motion.

He observed it as follows : —

1853.	M. T. Naples. h. m. s.	㉑ App. α h. m. s.	㉑ App. δ ° ′ ″
April 6	8 55 34	11 4 17.75	+6 48 40
7	9 16 48	11 3 50.15	+6 50 48

Here you have a new planet which was discovered a day earlier than the discovery of *Phocæa* by Mr. Chacornac at Marseilles. The symbol ㉑ belongs to this planet according to your notation ; and Professor Valz will have to exchange ㉑ for ㉕.

I can send you one more observation of Comet 1853, I., made by Mr. Privy-Councillor von Reedtz at his observatory in Palsgaard ; also elements of the same comet, computed by him from observations at Rome, March 7, Berlin, March 19, and his own of March 30. They are : —

T	1853, Feb. 24.02594 M. T. Berlin.	
π	153° 38′ 29″.8	Mean Equinox, 1853.215.
☊	69 56 25.4	
i	20 23 16.8	
Log. *q*	0.0388096	
	Motion Retrograde.	

1853.	M. T. Palsgaard. h. m. s.	☄ α	☄ δ	No. of Comp.
March 30	8 49 40.9	68° 4′ 3″.2	+9° 19′ 52″.0	2

Apparent Place of Comparison-Star.

✱ α h. m. s.	✱ δ
4 30 56.72	+9° 20′ 32″.1

A. C. PETERSEN.

THE SECOND COMET OF 1853.

Professor Petersen has communicated the following observations of the comet discovered by Professor Schweizer at Moscow, on the 4th of April.

At Königsberg.		M. T. Königsberg. h. m. s.	☄ α	☄ δ
	1853, April 16	13 23 48	306° 53′ 13″	+12° 33′ 50″
At Hamburg.		M. T. Hamburg. h. m. s.	☄ α	☄ δ
	1853, April 16	13 43 48	306° 55′ 48″.9	+12° 33′ 10″.9

ADDITION TO THE OBSERVATIONS OF BIELA'S COMET AT CAMBRIDGE (ENG.), IN 1845–46.

[Letter from Professor Challis to Professor Hubbard.]

In my former communication, the assumed places of only a portion of the comparison-stars depended on recent Cambridge observations. I have now completed the observations of the remainder, and the following is a list of corrections which, according to these observations, should be applied to the assumed R.A. or N. P. D. of the stars, and consequently to the resulting R.A. or N. P. D. of the comet.*

Star.	Correction to R.A. s.	Correction to N. P. D. ″	Star.	Correction to R.A. s.	Correction to N. P. D. ″
q	—0.37	+0.7	*t*	+0.00	—3.0
r	—0.22	—2.2	*v*	—0.40	+3.8
s	+0.09	+6.8	*w*	—0.29	—2.9
u	+0.04	—1.0	*x*	—0.29	—4.8

Star.	Correction to R.A. s.	Correction to N. P. D. ″	Star.	Correction to R.A. s.	Correction to N. P. D. ″
x′	—0.19	—2.0	*dd*	+0.02	+ 0.7
y	+0.56	+0.4	*gg*	—0.01	— 4.4
z	+0.59	—5.1	*hh*	+0.25	+ 0.5
aa	—0.01	+1.3	*ii*	—0.07	— 3.1
bb	—0.07	—0.4	*mm*	—0.54	+ 4.1
cc	—0.07	—2.9	*ll*	—0.25	+ 5.8
ee	+0.11	0.0	*kk*	+0.17	+12.6
ff	—0.27	—1.0			

I found in my memorandum-book that I noted the time of apparent coincidence of the comet on April 13 with a very small star, whose place I have just determined by equatorial observations. The result of this observation, which I believe to be pretty exact, is as follows: —

---

* These corrections have been incorporated into the table of residuals in pp. 76, 77 of this volume. H.

	Greenwich M. T. h. m. s.	R.A. of Comet. h. m. s.	$\log \frac{p}{P}$	N. P. D. of Comet. ° ′ ″	$\log \frac{q}{P}$
1846, April 13	8 48 53.0	8 49 10.88	+8.190	103 1 58.2	—9.9519

I have also gone over again my calculations of the relative positions of the two comets, which, as I before stated, depend partly on the separate determinations of their places, and partly on independent comparisons. I consider these results to be better than the former, a corrected value of the micrometer revolution having been employed in reducing them.

1846.	Greenwich M. T. h. m.	Difference of R.A. s.	Difference of N. P. D. ″	Weight of Result.
Jan. 23	7 8.2	5.18	123.3	5
24	7 1.3	5.11	127.3	4
27	6 25.5	5.84	145.4	4
28	6 19.2	5.77	151.9	4
29	7 22.8	5.44	155.3	4
Feb. 11	7 23.3	7.51	250.3	3
12	7 8.8	7.89	253.9	5
13	7 31.0	8.33	266.1	5
24	8 12.6	13.59	380.7	6

1846.	Greenwich M. T. h. m.	Difference of R.A. s.	Difference of N. P. D. ″	Weight of Result.
Feb. 25	7 14.3	13.99	391.4	8
27	8 1.3	15.30	415.1	4
28	7 31.5	16.72	427.9	1
Mar. 2	8 8.3	18.40	445.2	5
5	7 36.7	21.29	476.2	3
20	8 53.9	41.19	548.0	Doubtful.
25	8 50.7	46.26	507.1	2
27	9 7.3	47.37	482.4	2

As the observations of Biela's Comet at its last appearance will no doubt interest you, I send determinations which I have recently made of the places of the comparison-stars used at Cambridge and at Rome. Professor SECCHI left the places of his stars to be subsequently determined, but I have not yet seen them published.

Star.			Mean R.A. 1853.0. h. m. s.	No. of Obs.	Mean N. P. D. 1853.0. ° ′ ″	No. of Obs.	Place and Date of Comparison.
Astr. Nachr.,	No. 822,	(*s*)	7 29 33.82	2	68 12 32.4	2	Rome, Aug. 25.
"	No. 827,	(*b*)	7 40 5.99	4	68 50 42.2	4	" " 27.
		(*c*)	7 45 33.76	4	69 26 25.9	4	" " 28.
		(*d*) = H. C. 16130	8 7 30.33	4	70 51 36.9	4	" Sept. 1.
"	No. 836,	54 *Cancri*	8 42 49.86	3	74 6 27.7	2	Cambridge, Sept. 8.
"	No. 828,	∗ (mag. 10)	9 16 53.97	3	78 3 18.3	3	Rome, Sept. 15.
"	No. 836,	*h Leonis*	9 24 4.61	3	79 38 19.1	3	Cambridge, Sept. 16.
"	No. 832,	H. C. 19134	9 37 27.74	3	80 26 36.7	3	Rome, Sept. 19.
"	No. 832,	Weisse IX. 902	9 41 4.14	3	81 1 3.4	3	" " 20.
"	No. 836,	" 1011	9 46 53.32	2	82 13 21.5	3	Cambridge, Sept. 21.
"	No. 836,	" 1035	9 48 8.68	3	81 37 39.4	3	" " 21.

J. CHALLIS.

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OBSERVATIONS MADE AT THE HAMBURG OBSERVATORY.

By PROFESSOR CHARLES RÜMKER.

TWENTY-SECOND ASTEROID.

Date.	Hamburg M. T.	㉒ α	Log. Factor of Parallax.	㉒ δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars.	
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
1852, Dec. 11	7 55 33.0	72 12 57.2	9.7226*n*	+26 14 26.9	9.7500	9	4 52 13.17	+26 18 42.2
12	7 59 23.6	71 57 7.8	9.7096*n*	26 17 57.8	9.7422	7	" "	" "
17	8 54 38.9	70 39 35.0	9.5274*n*	26 34 34.1	9.6900	8	4 43 52.91	26 31 37.7
18	8 39 30.6	70 24 44.7	9.5582*n*	26 37 39.8	9.6952	10	4 39 14.78	26 41 53.7
1853, Jan. 4	8 32 22.1	67 0 12.8	9.2264*n*	27 22 21.4	9.6583	4	4 34 26.95	27 24 56.7
6	8 21 12.3	66 43 42.0	8.8698*n*	27 26 46.0	9.6450	2	4 25 36.80	27 13 16.8
9	9 27 53.6	66 21 53.9	8.7588	27 33 42.3	9.6427	5	4 25 36.76 4 28 1.72	27 13 17.0 27 37 14.7
11	9 0 17.6	66 9 56.7	7.2563	27 37 38.6	9.6408	2	4 21 11.12 4 28 1.79	27 48 10.0 27 37 14.6
Mar. 1	8 52 22.6	70 35 16.7	9.6602	29 33 12.8	9.6834	2	4 42 8.99	29 31 31.0
10	8 19 46.0	72 59 49.7	9.6474	29 58 39.5	9.6726	13	4 52 56.78 4 53 6.47	29 46 38.6 29 49 4.5
12	8 2 27.4	73 34 52.0	9.6201	+30 3 23.5	9.6621	15	4 54 50.88	+30 16 55.3

TWENTY-THIRD ASTEROID.

Date.	Hamburg M. T.	㉓ α	Log. Factor of Parallax.	㉓ δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars.	
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
1852, Dec. 18	9 54 9.2	47 31 46.5	8.9716	+17 0 45.9	9.7745	9	3 8 54.61	+17 1 43.0
1853, Jan. 2	8 35 18.0	46 18 53.1	8.7111	18 5 47.1	9.7622	5	3 5 46.04 3 5 56.42	17 45 42.3 17 47 29.5
3	6 10 27.0	46 18 27.7	9.5026*n*	18 10 24.2	9.7798	9	3 2 23.26	18 10 56.2
4	7 4 12.7	46 18 20.0	9.2380*n*	18 15 39.0	9.7653	9	" "	" "
5	6 29 59	48 18 43.9	9.4004*n*	18 20 47.5	9.7707	7	3 4 11.98 3 5 33.48	18 23 22.1 18 25 7.8
6	7 18 12.4	46 19 48.5	9.0398*n*	18 26 18.1	9.7608	12	3 5 33.47	18 25 7.7
9	7 35 6.0	46 26 17.8	8.5779*n*	18 42 48.8	9.7553	8	3 5 45.38	18 42 48.6
11	8 3 55.9	46 33 16.5	8.7938	18 54 11.1	9.7556	7	δ *Arietis.*	
Mar. 1	7 51 38.1	58 48 38.7	9.6100	24 31 14.5	9.7318	18	3 54 46.80	24 32 14.2
10	9 31 24.7	62 38 45.1	9.7894	25 33 8.4	9.7994	12	4 11 33.21	25 28 4.7
12	9 11 6.6	63 32 2.5	9.7770	+25 46 5.7	9.7886	8	4 11 33.18	+25 28 4.6

COMET 1853, I.

1853.	Hamburg M. T.	☄ α	Log. Factor of Parallax.	☄ δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars.	
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
March 27	8 10 24	68 13 4.6	9.7152	+7 53 47.2	9.8771	10	4 30 37.84 4 31 7.61	+7 52 35.4 7 34 24.9
28	8 11 56	68 9 59.2	9.7219	8 23 24.6	9.8719	7	4 30 15.31	8 23 42.5
30	8 9 35	68 4 41.4	9.7399	9 18 45.4	9.8761	12	4 30 56.77	9 20 32.4
31	8 25 21	68 2 34.3	9.7376	9 44 11.6	9.8764	7	4 30 36.56 4 31 38.85	9 53 32.3 9 35 39.9
April 5	8 39 35	67 57 43.4	9.7714	11 36 39.2	9.8792	16	4 31 51.38	11 54 11.7
9	9 6 58.3	67 58 37.8	9.7859	+12 52 2.5	9.8932	3	4 31 18.72	+12 50 1.6

IRIS.

1853.	Hamburg M. T.	⑦ α	Log. Factor of Parallax.	⑦ δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars by Meridian Observations.	
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
March 28	9 8 32.3	177 8 53.1	9.5238*n*	—7 48 48.2	9.9366	6	11 50 16.26	—7 43 59.2
29	10 16 47.1	176 55 0.8	9.3663*n*	7 41 34.3	9.9391	9	11 50 16.26	7 43 59.3
30	9 45 3.0	176 42 9.7	9.3731*n*	7 34 19.2	9.9385	7	11 46 28.69	7 34 35.5
31	9 37 46.6	176 29 22.1	9.3693*n*	7 27 56.4	9.9381	8	{ 11 43 41.35 { 11 45 6.87	7 10 32.4 —7 27 7.2
April 5	10 45 22.0	175 27 15.3		—6 53 3.5	9.9387		Meridian.	

TWENTY-FIFTH ASTEROID.

Professor Petersen has communicated the following observations of this planet, — made by Mr. **Luther** in Bilk, and Professor **Rümker** in Hamburg.

1853.	M. T. Bilk.	㉕ α	㉕ δ	No. Comp.	* α	* δ	Authority.
	h. m. s.	° ′ ″	° ′ ″		° ′ ″	° ′ ″	
May 2	10 0 8.5	220 13 41.3	—9 48 50.3	11	220 42 35.0	—9 47 35.9	B. Z. 243
4	12 53 35.6	219 45 56.5	—9 10 19.9	10	218 27 30.3	—9 10 47.5	B. Z. 244

1853.	M. T. Hamburg.	㉕ α	㉕ δ
	h. m. s.	° ′ ″	° ′ ″
May 18	10 58 45.2	218 4 14.8	—6 48 14.3

It has also been observed by Mr. **Ferguson** in Washington as follows: —

1853.	M. T. Washington.	No. of Obs.	*	㉕ — *		㉕ α	㉕ δ
				Δ α	Δ δ		
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
June 5	9 41 7.1	17	Weisse XI. 233	+1 18.68	+14 22.96	11 15 19.79	+5 15 15.48

G.

SIXTH NOTE ON THE DOUBLE STARS.

By Mr. YVON VILLARCEAU.

η Coronæ Borealis.

Those double stars whose elements may be regarded as known, at least approximately, are four in number. These are ξ *Ursæ Majoris*, *p Ophiuchi*, ζ *Herculis*, and η *Coronæ*.[1] This number would still farther be reduced to three, provided the double solution to which I have called attention[2] could continue at the present time. The object of the present note is to determine which one of these two solutions of the orbit of η *Coronæ* should be definitively adopted.

As will be remembered, the ambiguity which we have found arises from the fact, that the two components of the system are physically so little dissimilar that they can only be distinguished from one another by their relative positions. This distinction — although possible when relative positions are compared which are but slightly different, or separated by a short interval of time — ceases to be so, when the positions are referred to widely separated epochs, between which no observations were made. This difficulty presents itself in the case of two observations of W. **Herschel** made in 1781 and 1802, and consequently at an interval of 21 years; and the same interval of time separates the latter from the epoch 1823, when the series of observations commenced which has been continued without interruption up to the present time. Ought the observations of W. **Herschel** to be used as they were given at first, or should they be reversed, that is to say, changed by 180°? The condition that they must be capable of being represented by a system of elements which will also represent the modern observations, is the only one which can remove this difficulty.

Now, in preserving the position of 1802, I have found it necessary to reverse that of 1781, and have thus arrived at an orbit characterized by a revolution of about 66 years, and which no one had suspected. On the other hand, reversing the observation of 1802 and preserving unchanged that of 1781, I have obtained an orbit giving a revolution of nearly 43 years, — being the orbit which Sir **John Herschel** and Mr. **Mädler** had already pointed out, and which has been repeated from these astronomers in the greater part of the works which treat of this matter.

I have shown, in my first communication upon η *Coronæ*, that the result of the comparison of these two orbits with observations was incapable of establishing any sufficient motive for preference of either the one or the other of these two solutions. But a minute discussion of the physical circumstances of the two observations of W. Herschel showed the probabilities to be in favor of the orbit of 66 years. But however strong these probabilities might be, it would nevertheless be proper to refer to another epoch the question of deciding between these two solutions. We fixed for this epoch that at which the observations of η *Coronæ* in 1853 should be made, — pointing out the possibility of separating the two orbits before this time, in case the power of the great Pulkowa telescope should permit observations to be continued in spite of the great proximity of the component stars. As it is, the observations in Russia have been continued up to the present time, and the interest awakened by this subject has induced Messrs. Lassell and Hartnup to make observations in England, which they have had the goodness to communicate. Mr. Dawes has also shown me the courteous attention of transmitting a series of unpublished observations, which extend for η *Coronæ* as far as 1849 inclusive. These circumstances prompt me to present at the present time the results to which I have been conducted concerning the choice to be made between the two orbits; while at the same time I have profited by the new observations, to apply to the elements of the definitive orbit a correction, the opportunity for which I pointed out in closing my former communication.

---

[1] See **Humboldt**'s *Kosmos*, Vol. III. pp. 254, 258 and ff.

[2] *Comptes Rendus*, Vol. XXVIII. No. 13, Session March 26, 1849; *Add. à la Conn. d. Temps*, 1852.

At the first glance, it was easy to perceive that the series of observations made since 1847 could not accord with an orbit having a period of 43 years; and I have therefore given my attention to correcting the elements of the 66-year orbit. A difficulty here presented itself, which the insufficiency of the date prevented me from encountering in my first investigation, and which I had already experienced in the investigation of the orbit of η *Herculis*, though with a less marked character. I allude to the employment of distances in determining the elements of orbits of so close stars. In determining the elements of ζ *Herculis* by means of angles of position alone, I found it possible[1] to represent these angles well, — but the distances manifested systematic errors; making use of angles of position and of distances at the same time, the latter were represented better, but the systematic errors appeared in the angles of position.

In my new investigations concerning η *Coronæ*, an attempt to correct the elements by means of the simultaneous employment of the angles of position and of the distances, furnished me elements which leave, in the comparison of the angles of position, systematic errors which are very marked, and inadmissible when we consider the great precision with which angles of position are measured. I have consequently taken the course of employing these latter solely, and reserved the measurements of distances for the determination of the semiaxis major only. In this connection I will remark that five measurements of distance obtained by Mr. W. Struve between 1826 and 1835 exceed 0″.7; while seventeen other measurements obtained subsequently by the same astronomer and by MM. Otto Struve and Madler are comprised between 0″.6 and 0″.4. When it is desired to deduce other elements beside the semiaxis major from the measured distances, the results will depend especially upon the variations of distance, and it is manifest that the variations of distance comprised between 0″.6 and 0″.4 are quantities altogether comparable to the errors with which measures so difficult to obtain can be affected. As for the five other distances comprised between 0″.7 and 1″.15, the employment of their variations presents still other difficulties, to the consideration of which we will return in a moment. I have for these reasons felt obliged to employ only angles of position in the correction of elements other than the semiaxis major.

The following are the considerations which have guided me in deducing the semiaxis major.

The observations of MM. Struve can be grouped in two very distinct series, from two different points of view. The first, a series of eight measures, comprises those which Mr. Struve the father made at Dorpat between 1826 and 1838. The other includes twelve observations made for the most part by Mr. Otto Struve at Pulkowa, from 1839 to 1852. These two series are distinguished from one another as having been made by different observers, and also as having been made by the aid of different instruments. Two measures of distance are by Mr. Mädler, who obtained them in 1840 and 1841 with the Dorpat instrument.

In making use of the series of observations by Mr. Struve at Dorpat, I have had regard to the remarks of this eminent astronomer in the *Mensuræ Micrometricæ*, p. cliii. Mr. Struve, after reminding that the distance 0″.7 is too small to be measured by bisecting the two stars, shows that the very small distances below 0″.8 are not measured, properly speaking, but are rather estimated, according to the processes which he describes. By an attentive examination he has found proof that the accidental errors of such an estimate do not exceed those which are to be apprehended in the measures of distances comprised between 1″ and 2″. Nevertheless, the distances obtained by estimate deserve according to him less confidence. The small discrepancies of the estimates rather prove constancy of judgment than truth in the result obtained, and especially if the spaces to be compared are dissimilarly terminated. For this reason Mr. Struve instituted experiments upon artificial double stars of different apparent diameters, at angular distances of from 0″.22 to 0″.81, to determine the mean value of errors committed in estimating the distances. After giving a table containing the results of his experiments, Mr. Struve adds, that, according to his conviction, the estimate of the distances of very close celestial stars is made in the same manner as that of artificial stars. He entertains no doubt that the corrections of the table ought to be applied to distances smaller than 1″, and it does not appear probable to him that the errors affecting the distances thus corrected would attain the limit 0″.1.

---

[1] *Additions to the Connaissance des Temps, for* 1852.

In the presence of statements so precise as these, and emanating from the author himself of the observations which I had to employ, I have not hesitated to apply the corrections indicated ; but to facilitate the interpolation, I have substituted for Mr. STRUVE's another table, deduced by graphical interpolation from the numbers contained in that of Mr. STRUVE. The two tables are, as will be seen, but slightly different, and the only advantage of mine consists in a continuity which Mr. STRUVE's table does not possess to the same extent. The two tables are as follows : —

Distance Estimated.	Correction according to Mr. STRUVE	Correction obtained graphically.	Distance Estimated.	Correction according to Mr. STRUVE	Correction obtained graphically.
0″.30	+0″.13	+0″.128	0″.65		+0″.069
0.35		0.125	0.70	+0″.06	0.055
0.40	+0.12	0.120	0.75		0.042
0.45		0.113	0.80	+0.03	0.030
0.50	+0.10	0.105	0.85		0.018
0.55		0.094	0.90	+0.01	0.010
0.60	+0.07	0.082	0.95		+0.004
0.65		+0.069	1.00	0.00	0.000

In fact, we can perceive that the greatest discordance between the two tables does not reach 0″.01.

The corrections here indicated ought not to be regarded as definitive, for MM. STRUVE have not ended their experimental researches, and it may moreover be remarked, that the observations which have furnished the corrections for distances comprised between 0″.6 and 1″.0 are perhaps not sufficiently numerous.

The series of distances comprised between 0″.4 and 0″.6, and observed by Mr. OTTO STRUVE at Pulkowa, suggests a difficulty. Ought we or ought we not to apply to these observations the corrections given in the preceding table? This table was deduced by Mr. STRUVE the father, from his own observations made at Dorpat. The want of identity of the observers does not seem to oppose the application of the table to the second series, since the error of the estimate is attributed to the dissimilarity of the limits which bound the spaces compared. On the other hand, the instruments at Dorpat and Pulkowa are mounted under conditions differing but slightly, and eyepieces of about the same optical power are used with them. The most serious objection which can be urged against the use of Mr. STRUVE's table is relative to the somewhat uncertain portion of estimate and of direct measurement in the distances obtained by Mr. OTTO STRUVE. However this may be, the series of distances of *η Coronæ* furnished by this astronomer cannot be reconciled with those of Mr. W. STRUVE without corrections either constant or variable.

In the absence of positive data, and as an experiment, I decided to apply to the observations of distance by Mr. OTTO STRUVE corrections deduced from the preceding table, so that the result obtained by the employment of these distances can be admitted only upon the condition of being verified in some other way. Moreover, it is almost unnecessary to call attention to the fact, that it is only the determination of the semiaxis major which is here under discussion.

As for the two distances observed by Mr. MÄDLER with the Dorpat telescope, it is manifest from what has been said, that we can apply to them STRUVE's corrections. This I have done.

Finally, I have taken, in determining the semiaxis major, no account of three distances observed, one by Sir JOHN HERSCHEL and the two others by Mr. DAWES, inasmuch as the differences between the distances as measured by these astronomers and those of Mr. STRUVE did not appear to me to be determined with sufficient exactitude in the case where these distances are very small. We will return to the observations of Mr. DAWES shortly.

The observations of angles of position which I have employed to correct the elements of the orbit of *η Coronæ* are 37 in number, and comprise all those which have come to my knowledge. The equations of condition have been treated by the method of least squares, and have conducted me to the following elements (the semiaxis major excepted) : —

ELEMENTS OF THE ORBIT OF *η CORONÆ BOREALIS.*

$$\left.\begin{array}{l}\alpha = \ \ 15^{\text{h.}}\ 17^{\text{m.}}\ 0^{\text{s.}} \\ \delta = +30^\circ\ 50'\end{array}\right\}\ 1850.$$

Perihelion Passage, ...	1779.338 ; 1846.647
Mean yearly Motion, . . .	5°.3484
Angle (sin = eccentricity), . .	23° 51′.0
Longitude of Ascending Node, .	9 52.3
Longitude of Perihelion, . .	194 51.9
Inclination, ...	± 59 18.6
Semiaxis major, ...	1″.2015

The longitudes are counted from the meridian of 1850 (yearly motion = —0′.294).

Hence we obtain

Period of Revolution, ...	67y.309
Eccentricity, ...	0′.40433

		Dates.	Position.	Distance.
Smallest apparent	perihel.,	1786.068 ; 1853.377	264° 53′	0″.4830
Largest "	aphel.,	1811.942 ; 1879.251	11 5	1.6851
Largest "	perihel.,	1771.431 ; 1838.740	116 20	0.5159
Smallest "	aphel.,	1778.744 ; 1846.053	188 15	0.7170

The angles of position are counted from the meridian of 1850.

These elements, compared with those which I published in the *Additions* to the *Conn. des Temps*, present but slight differences ; — the greatest angular difference, namely, that of the position of the node, is 5° 31′ ; the period of revolution has been increased by one year, and the time of the perihelion passage by about three months.

Before going on to state the manner in which the semiaxis major has been obtained, let me give the result of the comparisons of all the observations with these corrected elements.

η Coronæ.

Comparison of the Elements with all the Observations.

Observations.					Observers.	Correction of Distances.	Corrected Distances.	Ratio of the Distance to the Semi-axis Major deduced from the Elements.	Angle of Position. Observed — Calculated		Corrected *minus* Calculated Distance.
Date.	Angles of Position.	Distance.	Mean Magnif. Power.	No. of Days.					Angle.	In Arc.	
1781.69	210° 41′		932?	1	W. Herschel.			0.5346	—0° 12′	—0″.002	
1802.69	359 40			1	Id.			1.2406	+1 5	+0.028	
1823.27	25 57			2	J. Herschel and South.			1.1681	—1 33	—0.038	
1826.77	35°.28	1″.154 (1)	600	4 and 3	W. Struve.	0″.000	1″.154	1.0060	+0 24	+0.008	—0″.055
1829.55	43.25	0.960	600	2	Id.	+0.003	0.963	0.8527	+0 19	+0.006	—0.061
1830.303	44 28	0.820			J. Herschel.	0	0.820	0.8084	—1 11	—0.020	(—0.151)
1831.36	51 12				Dawes.			0.7452	+1 10	+0.018	
1831.42	52 30			10	J. Herschel.			0.7416	+2 12	+0.034	
1831.63	50.63	0.883	600	3	W. Struve.	+0.012	0.895	0.7290	—0 38	—0.010	+0.019
1832.48	56 42			10	J. Herschel.			0.6779	+1 8	+0.016	
1832.55	56 42				Dawes.			0.6738	+0 45	+0.011	
1832.76	56.87	0.790	933	3	W. Struve.	+0.032	0.822	0.6613	—0 14	—0.003	+0.027
1833.28	62 6			8	J. Herschel.			0.6307	+1 53	+0.025	
1833.39	63 31				Dawes.			0.6243	+2 36	+0.034	
1835.41	74.28	0.730	900	6	W. Struve.	+0.047	0.777	0.5163	—2 23	—0.026	+0.157
1836.52	88.77	0.563	967	6	Id.	+0.091	0.651	0.4703	+0 39	+0.006	+0.089
1837.47	95.44	0.385	900	4	W. and O. Struve.	+0.122	0.507	0.4432	—4 7	—0.038	—0.025
1838.44	107.04	0.366	1000	5	Id.	+0.123	0.489	0.4302	—5 17	—0.048	—0.028
1839.82	127.05	0.586	609	3	O. Struve.	+0.085	0.671	0.4390	—3 45	—0.035	+0.144
1840.52	137.80	0.518	1036	6	Id.	+0.101	0.619	0.4542	—1 46	—0.017	+0.073
1841.43	150 24	0.480			Mädler.	+0.108	0.588	0.4815	+0 25	+0.004	+0.010
1841.50	151.25	0.522	936	4	O. Struve.	+0.100	0.622	0.4838	+0 31	+0.005	+0.041
1842.21	157 58.5	0.5			Mädler.	+0.105	0.605	0.5084	+0 1	0.000	—0.006
1843.30	165.00	0.570	858	3	O. Struve.	+0.089	0.659	0.5460	—2 44	—0.031	+0.003
1845.61	183.13	0.577	910	5	W. and O. Struve.	+0.087	0.664	0.5953	—2 2	—0.025	—0.051
1846.61	193.93	0.557	858	3	O. Struve.	+0.087	0.644	0.5943	+1 45	+0.022	—0.070
1846.88	196 46		435		Dawes.			0.5914	+2 41	+0.033	
1847.64	201.78	0.495	858	5	O. Struve.	+0.106	0.601	0.5775	+2 8	+0.026	—0.093
1848.00	204.05	0.658	476	4	Dawes.	0	0.658	0.5681	+1 41	+0.020	(—0.025)
1848.72	207.80	0.495	1013	2	O. Struve.	+0.106	0.601	0.5449	—0 22	—0.004	—0.054
1849.44	218.28	0.694	500	2	Dawes.	0	0.694	0.5173	+3 45	+0.041	(+0.073)
1849.65	214.63	0.517	858	3	O. Struve.	+0.101	0.618	0.5087	—1 54	—0.020	+0.007
1850.52	221.50	0.437	936	4	Id.	+0.114	0.551	0.4727	—4 3	—0.040	—0.017
1851.35	236 37			2	Hartnup.			0.4111	+1 7	+0.010	
1851.40	239 18			3	Lassell.			0.4394	+3 9	+0.029	
1851.56	233.26	0.412	1076	10	O. Struve.	+0.118	0.530	0.4340	—5 0	—0.015	+0.009
1852.62	257.98	0.402	1065	6	Id.	+0.120	0.522	0.4080	+4 41	+0.040	+0.032

N. B. — Those numbers in the last column which are included in parentheses refer to distances which were not used in the determination of the semiaxis major.

Let me now describe the manner in which I have determined the semiaxis major. The other elements obtained by means of the angles of position alone have made it possible to compute the several values of the ratio of the distance to the semiaxis major.

Let ϱ' be this ratio; A, the semiaxis major; and ϱ, the distance observed and corrected conformably to the indications of Mr. STRUVE. We have then for every observation of distance an equation of the form $\varrho = \varrho' A$.

Discussing according to the method of least squares the whole system of equations which depend upon the observations of Mr. W. STRUVE, then in the same manner those of Mr. OTTO STRUVE and those of Mr. MÄDLER, I have obtained the following three equations: —

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(1) The mean 1″.154 differs from the number 1″.075 published in the *Mensuræ Micrometricæ*. I have obtained the former by suppressing one of the four observations (0″.84) which appeared too different from the others, and then referring the observations retained to the mean epoch 1826.77, taking account of the variations of the distance with reference to the time.

By 8 observations of Mr. W. Struve, $4''.3217 = 3.5770\,A$, whence $A = 1.2082$
" 12 " " O. Struve, $3.7067 = 3.1063\,A$, " $A = 1.1933$
" 2 " " Mädler, $0.5908 = 0.4903\,A$, " $A = 1.205$

By the whole 22 observations, $8.6192 = 7.1736\,A$, whence $A = 1.2015$

The greatest difference of any one of these three determinations from the final result amounts only to 0″.008; and so close an agreement would tend to justify the application which I have made to the observations of MM. O. Struve and Mädler, of the corrections which could be only legitimately applied to the observations of Mr. Struve the father.

As for the difference between the values of the semiaxis major corresponding to MM. Struve, I find it here to be 0″.015. It has the same sign and is precisely equal to the difference which I pointed out[1] between the values of the semiaxis major of the orbit of *p Ophiuchi*, relative to these two observers. In the latter case, the quantity under consideration was about 5″, and as all the distances exceeded 1″ they had no need of any correction. But at any rate, the exact coincidence which we find here should be regarded as purely accidental; in fact, the change of one of the distances by a few hundredths of a second would suffice to destroy this perfect coincidence.

Taking the corrections applied to the twelve distances of Mr. Otto Struve and the corresponding differences between the corrected observation and calculation, we find their sums to be 1″.214 and 0″.021, and their means respectively +0.101 and +0.002. If we admit that the accuracy of the value of the semiaxis major is sufficiently proved by the smallness of the discrepancies between the partial results and the mean result, we find as a consequence that the mean correction to be applied to the distances as observed by Mr. Otto Struve between the limits 0″.4 and 0″.6 is 0″.099, or very nearly the tenth of a second. The variations of the corrections employed between these limits do not exceed 0″.02 from this mean, whence it would follow that the errors of Mr. O. Struve between these limits are sensibly constant. To be sure, these are but presumptions, and especially submitted for the examination of the skilful astronomer to whose courtesy we are indebted for the communication of this series of observations.

We have thus far omitted the consideration of the two measures of distance obtained by Mr. Dawes, because the smallness of the optical power of his instrument, as compared with those of Dorpat and Pulkowa, would lead us to consider the measures of minute distances as hardly comparable to those which have been obtained in Russia. Nevertheless, the errors +0″.025 and +0″.073, deduced from a value of the semiaxis major obtained without the aid of Mr. Dawes's observations, show that the observations of this distinguished astronomer are not so far from being comparable to those of MM. Struve as might at first have been apprehended. The semiaxis major which the two measures of Mr. Dawes give is 1″.241, a value which only differs by 0″.040 from our general mean. Still it is necessary to remark, that, as this result is deduced from observed quantities which are nearly one half less than the results obtained, the influence of the errors of observation is almost doubled.

In spite of the quite remarkable accordance of the values of the semiaxis major, it must be acknowledged that the errors of the corrected distances are far from attaining the same degree of smallness as the errors with which the angles of position are affected. Independently of what doubt might remain concerning the legitimateness of the corrections applied, the result of the comparison of the distances[1] shows that we ought to hold to the use of the angles of position in determining the principal elements of the orbit.

Casting a glance at the differences relative to the angles of position given in the preceding table, it will be remarked that the largest of these differences when reduced to arc amounts to only 0.″048. The whole series gives for the probable error of an angle of position, expressed in the same manner, the number 0″.0188. Now Mr. Struve has shown that the probable error of the mean of three observations of an angle of position reduced to arc varies from 0″.018 to 0″.028 for the distances comprised between 0″.70 and 1″.48. The preceding result accords very well with the experimental determinations of Mr. Struve.

Our table appears to show traces of a systematic error between the epochs 1837 and 1840. It will be observed that this epoch includes an apparent perihelion passage, and moreover, that there are no observations but those of MM. Struve. Between 1846 and 1848 some errors with the same sign are to be found, but these are very slight. Finally, the somewhat sensible errors of the last two observations, which amount respectively to —0″.045 and +0″.040 can be attributed to the very great proximity of the stars, for the companion is approaching the apparent perihelion, which will be reached in 1853.377, the distance being reduced at this time to 0″.484.

The traces of systematic errors of which I have spoken cannot entirely disappear until the astronomers shall have themselves determined, by observations or special experiments, the law of the errors which affect the angles of position according to the angle formed with the horizon by the straight line which joins the images of the stars. We have reason to hope that MM. Struve will soon communicate the result of their researches upon this subject.

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[1] *Add. à la Conn. des Temps*, 1852, p. 197.

[1] With regard to the observation of 1839, it ought to be remarked, according to Mr. Otto Struve, that the observations of this year cannot be taken into consideration, because it was in 1839 that he began to apply himself to micrometrical measures, and that his observations made at that time could not claim the precision which experience has since enabled him to attain. Therefore the deviation +0″.144 of the distance measured in 1839 ought not to surprise us.

In spite of the discordances which still exist in the comparison of the angles of position, we may consider our elements as representing the observations in a very satisfactory manner. It remains to state how they are satisfied by the orbit of 43 years. I confine myself to the comparison of the last two observations of Mr. Otto Struve, with the elements (second solution) published in the *Additions* to the *Conn. des Temps.*

The result of the comparison is

Date.	Angle Obs. — Angle Calc.	Dist Obs. — Dist. Calc.	Cor. Dist. — Dist. Calc.
1851.56	—104° 7′	—0″.035	+0″.083
1852.62	— 91 30	—0.213	—0.093

We shall have a more approximate value for the discordance between the two orbits as regards the angles of position, if we correct the observations of Mr. Otto Struve by the errors indicated by the preceding comparison. We thus obtain for the difference between the observed and the calculated angles

Date.	
1851.56	—99° 7′
1852.62	—96 11

or about —97° 5′ for the beginning of 1852. Now, such a discordance is not one which can be made to disappear by slight changes in the elements, and we are therefore justified in rejecting the orbit of 43 years' period, and in considering the orbit of 67 years as being that which the companion of η *Coronæ* really describes.

The period of revolution 67ʸ.309 does not appear to me susceptible of being materially modified by later observations, inasmuch as the position corresponding to the observation of Sir W. Herschel has been reached and passed during the last few years. The period cannot therefore be affected by any uncertainty greater, at the most, than the time during which an angle of position would be described equal to the algebraic difference between the mean error of the modern observations and that of the observation of W. Herschel. It is readily seen, that this uncertainty cannot exceed a year. Now the period 66ʸ.257 satisfies all the observations anterior to 1848, and it is therefore manifest that, if the true time of a revolution exceeds 67.309, it can be but by a small fraction of a year.

Let me add in closing, that having applied to the observations of MM. Struve alone the method set forth in my third memoir upon the double stars, without subjecting them to any corrections dependent upon the distances, I obtained immediately an orbit, a little indeterminate it is true, but in which the period of revolution was 69ʸ.3. Thus, without recurring to the ancient observation of Herschel, the series of observations of MM. Struve is already sufficient to give a tolerably approximate idea of the orbit of η *Coronæ.*

Paris, 1853, *March* 30.

LETTER FROM MR. CHARLES S. VENABLE TO THE EDITOR.

Bonn, 1853, *May* 16.

I take the liberty of a fellow-citizen to communicate to you, at Professor Argelander's request, the discovery of a planet by Mr. Luther in the Observatory of Bilk, together with several positions of the same.

	M. T. Bilk.	App. R.A.	App. Decl.
	h. m.	° ′	° ′
1853, May 5	13 0	207 40	—10 15
14	11 52	206 3	— 9 57

	M. T. Bonn.	App. R.A.	App. Decl.
	h. m. s.	° ′ ″	° ′ ″
1853, May 15	12 0 41	205 53 41	—9 55 46.5

The Bonn position is obtained from four comparisons with the ring-micrometer.

I send also Elements and an Ephemeris of the planet discovered by Gasparis on the 6th of April. They are computed by Messrs. Förster and Krüger here in Bonn.

Elements of the Twenty-Fourth Asteroid.

From observations in Naples, April 6 and 13, and Bonn, April 27 and May 10.

Epoch, 1853, May 10.431400, Mean Berlin Time.

M	341° 52′ 26″.3	Mean Equinox, 1853.0.
☊	32 26 35.3	
π	213 32 44.2	
ω	181 6 8.9	
i	0 53 46.8	
φ	14 21 14.2	
Log. a	0.561038	
" μ	2.708450	

The observations are represented by these elements as follows: —

	C. — O. $\Delta\lambda$	C. — O. $\Delta\beta$		C. — O. $\Delta\lambda$	C. — O. $\Delta\beta$
April 6	—0″.4	+31″.6	April 27	+1″.0	— 0″.8
13	—0.2	— 0.9	May 10	+0.1	—18.3

Ephemeris for Mean Berlin Midnight.

1853.	㉔ α	㉔ δ	Log △
	h. m. s.	° ′ ″	
May 20	11 5 17.7	+6 18 12	0.37289
21	5 47.9	14 39	
22	6 19.2	10 59	
23	6 52.0	7 13	
24	7 25.6	6 3 19	0.38133
25	8 0.4	5 59 18	
26	8 36.3	55 10	
27	9 13.3	50 57	
28	9 51.2	46 35	0.38965
29	10 30.3	42 8	
30	11 10.1	37 35	
31	11 51.0	32 57	
June 1	12 32.9	28 10	0.39787
2	13 15.9	23 17	
3	13 59.8	18 18	
4	14 44.6	13 12	
5	15 30.4	8 1	0.40601
6	16 17.0	5 2 45	
7	17 4.7	4 57 23	
8	11 17 53.2	+4 51 55	

1853.	㉔ α	㉔ δ	Log △
	h. m. s.	° ′ ″	
June 9	11 18 42.7	+4 46 22	0.41403
10	19 32.7	40 42	
11	20 23.7	34 57	
12	21 15.6	29 6	
13	22 8.5	23 10	0.42214
14	11 23 1.9	+4 17 8	
June 15	11 23 56.3	+4 11 0	
16	24 51.3	4 4 47	
17	11 25 47.1	+3 58 28	0.43025

I have forgotten to state that the planet discovered at Bilk is of the 11 magnitude, or perhaps 10.11.

CHARLES S. VENABLE.

ELEMENTS AND EPHEMERIS OF EUNOMIA.

By Mr. GEORGE RÜMKER.

Epoch, 1851, August 21.

M	314° 21′ 55″.5	1852, Jan. 0.0, Berlin M. T.
π	27 53 58.3	Mean Equinox, 1852, Jan. 0.0.
☊	293 54 30.0	
i	11 43 59.6	
φ	10 49 33.4	
μ	825.58134	
Log. a	0.4221645	

MEAN BERLIN MIDNIGHT.

1854.	⑮ α	⑮ δ	Log. △	Log. r
	h. m. s	° ′ ″		
Feb. 24	11 50 53.51	—15 2 36.4	0.330965	0.481853
25	50 6.92	1 59.9	.329855	
26	49 19.43	1 11.4	.328793	0.482162
27	48 31.13	15 0 11.1	.327781	
28	47 42.07	14 58 59.1	.326820	0.482467
Mar. 1	46 52.29	57 35.3	.325911	
2	46 1.86	55 59.9	.325054	0.482768
3	45 10.82	54 13.0	.324251	
4	44 19.22	52 14.8	.323502	0.483066
5	43 27.10	50 5.3	.322809	
6	42 34.53	47 44.8	.322171	0.483361
7	41 41.56	45 13.4	.321589	
8	40 48.23	42 31.2	.321065	0.483652
9	39 54.60	39 38.5	.320598	
10	39 0.73	36 35.5	.320190	0.483940
11	38 6.66	33 22.4	.319840	
12	37 12.45	29 59.5	.319548	0.484225
13	36 18.15	26 26.9	.319316	
14	35 23.82	22 45.0	.319143	0.484508
15	34 29.51	18 54.0	.319029	
16	33 35.26	14 54.1	.318975	0.484788
17	32 41.14	10 45.6	.318981	
18	31 47.19	6 28.9	.319047	0.485065
☊ 19	30 53.47	14 2 4.2	.319173	
20	30 0.04	13 57 31.9	.319359	0.485338
21	29 6.95	52 52.3	.319605	
Mar. 22	11 28 14.22	—13 48 5.7	0.319910	0.485607
Mar. 23	11 27 21.94	—13 43 12.5	0.320275	
24	26 30.16	38 13.2	.320699	0.485873
25	25 38.92	33 8.0	.321182	
26	24 48.27	27 57.4	.321723	0.486136
27	23 58.26	22 41.7	.322322	
28	23 8.93	17 21.4	.322979	0.486396
29	22 20.35	11 56.7	.323692	
30	21 32.56	6 28.1	.324462	0.486652
31	20 45.60	13 0 56.0	.325287	
April 1	19 59.51	12 55 21.0	.326167	0.486906
2	19 14.33	49 43.4	.327101	
3	18 30.11	44 3.6	.328088	0.487157
4	17 46.87	38 22.0	.329127	
5	17 4.65	32 39.0	.330216	0.487406
6	16 23.48	26 55.0	.331355	
7	15 43.39	21 10.4	.332542	0.487651
8	15 4.40	15 25.5	.333777	
9	14 26.54	9 40.6	.335058	0.487892
10	13 49.84	12 3 56.2	.336384	
11	13 14.31	11 58 12.6	.337754	0.488129
12	12 39.98	52 30.1	.339166	
13	12 6.87	46 49.0	.310621	0.488364
14	11 35.00	41 9.8	.342117	
15	11 4.39	35 32.6	.343653	0.488596
16	10 35.07	29 57.9	.345229	
April 17	11 10 7.05	—11 24 25.8	0.346845	0.488826

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ON THE ORBIT OF BIELA'S COMET IN 1845-46.

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§ 4.

A REVIEW of our table of observations shows now but twelve whose comparison-stars have not been specially determined; and these, as containing an additional source of error, without the power of contributing materially to an accurate result, have been omitted in the preparation of the final normals. The normals themselves have been composed of nearly the same observations as before; for although their number might now be reduced with safety, I wished to retain as many points of comparison as possible. The adopted values, with the probable errors of the mean and of a single observation, are as follows: —

	$\Delta\alpha\,.\cos\delta$	No. of Obs.	Probable Error of Normal.	Log. Weight.	Probable Error of single Obs.	$\Delta\delta$	No. of Obs.	Probable Error of Normal.	Log. Weight.	Probable Error of single Obs.
Dec. 1	+11″.1	2				— 1″.9	4			
27	+ 2.3	12	1″.51	9.64398	5″.22	— 4.2	11	1″.73	9.52160	5″.75
Jan. 20	— 0.4	15	1.02	9.98634	3.93	— 0.5	15	.87	0.12326	3.36
28	— 1.1	15	.87	0.12198	3.37	+ 1.8	15	.76	0.23566	2.95
Feb. 9	+ 0.3	13	1.44	9.68434	5.19	+ 0.3	13	1.33	9.74984	4.81
17	— 3.0	14	.90	0.09460	3.36	+ 2.5	14	.90	0.08924	3.38
25	+ 0.7	12	.78	0.21032	2.72	+ 1.7	11	1.39	9.71124	4.63
Mar. 5	+ 2.5	15	1.08	9.93656	4.17	— 1.0	14	1.15	9.87744	4.31
13	+ 2.7	16	.68	0.33402	2.72	— 0.2	15	.88	0.10694	3.42
21	+ 1.5	17	.98	0.01822	4.04	— 0.4	18	.58	0.47682	2.45
29	— 1.7	17	1.79	9.49252	7.40	— 1.3	17	1.31	9.76248	5.42
Apr. 18	+ 1.2	4				—23.6	4			

The different degrees of accuracy of a single observation, as here exhibited, are accounted for partly by the presence or absence of the moon, and partly by the changes manifested in the comet itself, particularly towards the middle of February, when it suddenly became for a few days quite faint and difficult of observation. To the first and last normals I have given the weight of $\frac{1}{4}$. We thus have the following equations, already multiplied by their weights: —

Right Ascensions.

	n	ΔM	$\Delta\Omega_0$	$\Delta\omega_0$	Δi_0	$\Delta\varphi$	$\Delta 100\mu$
Dec. 1	+2″.76	9.49167	9.39685	9.37919	*n*9.03791	*n*9.90712	*n*9.92494
27	+1.03	9.76360	9.42579	9.48215	*n*9.26941	*n*0.13734	*n*0.13468
Jan. 20	—0.43	0.23513	9.59577	9.66288	*n*9.53299	*n*0.50703	*n*0.48973
28	—1.50	0.42568	9.61683	9.72103	*n*9.60793	*n*0.66295	*n*0.64386
Feb. 9	+0.13	0.10028	8.93194	9.11709	*n*9.00743	*n*0.26852	*n*0.24740

	n	ΔM	$\Delta\Omega_0$	$\Delta\omega_0$	Δi_0	$\Delta\varphi$	$\Delta 100\mu$
Feb. 17	—3″.72	0.62369	9.06866	9.37171	*n*9.21561	*n*0.71149	*n*0.69216
25	+1.11	0.88999	9.02580	9.34643	*n*8.94600	*n*0.84962	*n*0.83492
Mar. 5	+2.15	0.78908	9.09411	9.15411	*n*7.38782	*n*0.56098	*n*0.55573
13	+5.83	1.34957	9.93253	9.86789	*n*8.57991	*n*0.84923	*n*0.86543
21	+1.62	1.15191	9.93337	9.85461	*n*9.12101	*n*0.14569	*n*0.24765
29	—0.52	0.67836	9.59805	9.52893	*n*8.96480	9.52111	9.20505
Apr. 18	+0.31	0.48945	9.62495	9.58541	*n*9.14510	0.04162	9.97713

Declinations.

	n	ΔM	$\Delta\Omega_0$	$\Delta\omega_0$	Δi_0	$\Delta\varphi$	$\Delta 100\mu$
Dec. 1	—0″.49	8.97120	8.13732	8.94775	9.45184	*n*9.47775	*n*9.49804
27	—1.41	*n*9.36134	7.49513	8.58562	9.58241	*n*9.41857	*n*9.43619
Jan. 20	—0.66	*n*0.50639	*n*8.37160	*n*9.26408	0.17010	*n*9.90236	*n*9.90920
28	+3.15	*n*0.76072	*n*8.76533	*n*9.63435	0.26341	*n*0.04061	*n*0.04032
Feb. 9	+0.17	*n*0.47094	*n*8.66128	*n*9.41943	9.71467	*n*9.70601	*n*9.68746
17	+3.08	*n*0.92856	*n*9.24192	*n*9.90634	9.96752	*n*0.20318	*n*0.17580
25	+0.87	*n*0.65502	*n*9.08936	*n*9.65956	9.42389	*n*9.99856	*n*9.96569
Mar. 5	—0.75	*n*0.90479	*n*9.45412	*n*9.94016	9.17849	*n*0.33125	*n*0.29591
13	—0.31	*n*1.18369	*n*9.83712	*n*0.25862	*n*9.35117	*n*0.69879	*n*0.66351
21	—1.07	*n*1.55202	*n*0.28867	*n*0.67640	*n*0.23147	*n*1.15391	*n*1.12058
29	—0.75	*n*0.77944	*n*9.57060	*n*9.95801	*n*9.72719	*n*0.45652	*n*0.42606
Apr. 18	—5.89	*n*0.14238	*n*8.96136	*n*9.42689	*n*9.53979	*n*9.92528	*n*9.89956

The inconvenience presented by the near equality of the coefficients of $\Delta\varphi$ and $\Delta 100\mu$, and the consequent indeterminateness of one of the quantities except as a function of the other, might perhaps have been avoided by the selection of different elements or combinations of elements; but I preferred rather to retain the present form, and render the results functions of $\Delta\mu$, leaving this to be subsequently determined with more certainty by other means.

The final equations are, —

$$
\begin{aligned}
0 &= 169''.9011 + 2612.671\,\Delta M + 125.7283\,\Delta\Omega_0 + 258.1274\,\Delta\omega_0 + 33.7410\,\Delta i_0 + 355.4331\,\Delta\varphi + 299.5284\,\Delta 100\mu\\
0 &= 8.9162 + 125.7283\,\Delta M + 6.8419\,\Delta\Omega_0 + 13.4850\,\Delta\omega_0 + 2.6410\,\Delta i_0 + 21.0387\,\Delta\varphi + 18.0827\,\Delta 100\mu\\
0 &= 9.3507 + 258.1274\,\Delta M + 13.4850\,\Delta\Omega_0 + 30.7316\,\Delta\omega_0 + 6.1815\,\Delta i_0 + 70.1402\,\Delta\varphi + 63.6825\,\Delta 100\mu\\
0 &= 11.8533 + 33.7410\,\Delta M + 2.6110\,\Delta\Omega_0 + 6.1815\,\Delta\omega_0 + 10.7799\,\Delta i_0 + 26.7566\,\Delta\varphi + 24.7837\,\Delta 100\mu\\
0 &= -18.2510 + 355.4331\,\Delta M + 21.0387\,\Delta\Omega_0 + 70.1402\,\Delta\omega_0 + 26.7566\,\Delta i_0 + 427.8871\,\Delta\varphi + 407.5062\,\Delta 100\mu\\
0 &= -22.6721 + 299.5284\,\Delta M + 18.0827\,\Delta\Omega_0 + 63.6825\,\Delta\omega_0 + 21.7837\,\Delta i_0 + 407.5062\,\Delta\varphi + 388.9028\,\Delta 100\mu
\end{aligned}
$$

And the elimination gives, —

$$
\begin{aligned}
\Delta M &= +\,0''.213 + 2.239\,.\,\Delta\mu\\
\Delta\Omega_0 &= +\,3.982 + 38.683\,.\,\Delta\mu\\
\Delta\omega_0 &= -\,1.761 - 27.686\,.\,\Delta\mu\\
\Delta i_0 &= -\,0.449 + 4.666\,.\,\Delta\mu\\
\Delta\varphi &= -18.366 - 94.751\,.\,\Delta\mu
\end{aligned}
$$

$$
\begin{aligned}
nn\,.\,6 &= 78''.901 - 32.184\,.\,\Delta\mu + 83.5\,\Delta\mu^2\\
&= 75.800 + 83.5\,(\Delta\mu - 0''.19272)^2.
\end{aligned}
$$

The value of $\Delta\mu$ which will render $nn\,.\,6$ a minimum is +0″.19272. This, though subject to great uncertainty for the reason mentioned above, is yet the best that can be obtained from the present data, and, substituted in the above, gives the following

ELEMENTS III.

	°	′	″			°	′	″
M	0	0	2.86	+ 2.239 . $\Delta\mu$				
Ω_0	327	3	40.74	+ 38.683 . $\Delta\mu$	Ω	215	51	2.85
ω_0	139	36	49.86	— 27.686 . $\Delta\mu$	ω	223	8	16.83
i_0	21	27	8.63	+ 4.666 . $\Delta\mu$	i	12	31	57.86
φ	49	10	19.22	— 94.751 . $\Delta\mu$				
μ			537″.00539	+ $\Delta\mu$				

The residuals, still multiplied by their weights, now become, —

	$\Delta\alpha\cos\delta$		$\Delta\delta$	
Dec. 1	+2″.1	—4.42 . $\Delta\mu$	—1″.3	—3.10 . $\Delta\mu$
27	+0.7	—4.02 . $\Delta\mu$	—2.1	—2.14 . $\Delta\mu$
Jan. 20	+0.1	+0.46 . $\Delta\mu$	—2.7	—1.57 . $\Delta\mu$
28	—0.4	+1.17 . $\Delta\mu$	+0.6	—0.36 . $\Delta\mu$

	$\Delta\alpha\cos\delta$		$\Delta\delta$	
Feb. 9	+0″.6	+1.09 . $\Delta\mu$	—0″.5	+0.76 . $\Delta\mu$
17	—3.0	+2.05 . $\Delta\mu$	+2.0	+2.28 . $\Delta\mu$
25	+1.0	+1.36 . $\Delta\mu$	+0.6	+1.05 . $\Delta\mu$
Mar. 5	+1.2	—0.11 . $\Delta\mu$	—0.8	+1.32 . $\Delta\mu$
13	+1.1	—1.34 . $\Delta\mu$	0.0	+1.17 . $\Delta\mu$
21	—1.5	+0.17 . $\Delta\mu$	+0.1	—1.05 . $\Delta\mu$
29	—1.5	+0.79 . $\Delta\mu$	—0.5	—0.86 . $\Delta\mu$
Apr. 18	+0.1	+2.50 . $\Delta\mu$	—5.7	—0.44 . $\Delta\mu$

These results appear to justify the conclusion that we have, in the observations of this comet during its visibility in 1845–46, no sensible trace of the action of any other force than gravitation. This amounts simply to the proof, that with this comet, as with others whose motions have been carefully investigated, the inequalities produced by extraneous forces are either of comparatively long period, so that the resulting curve will nearly osculate with the apparent path; or that the coefficients of these inequalities are so small as entirely to elude our present powers of observation. The existence of such forces is not hereby denied, it is asserted from more than one other source, and the hope is not ill-founded, that ere long their nature and laws may be included within the domains of our knowledge.

§ 5.

The last-obtained corrections of elements substituted in the original equations gave the following table of corrections in α and δ, and these, applied to the places already computed from Elements II., gave an apparent path for the primary nucleus which may be considered as fully representing the observations.

	$\Delta\alpha$	$\Delta\delta$		$\Delta\alpha$	$\Delta\delta$
Jan. 8	+0″.7	—1″.7	Jan. 28	+0″.8	—1″.5
12	0.7	1.7	Feb. 1	0.9	1.4
16	0.7	1.6	5	0.9	1.3
20	0.8	1.6	9	0.9	1.1
24	+0.8	—1.6	13	+0.7	—1.0

	$\Delta\alpha$	$\Delta\delta$		$\Delta\alpha$	$\Delta\delta$
Feb. 17	+0″.5	—0″.9	Mar. 13	—2″.2	+0″.2
21	+0.2	0.7	17	2.6	0.3
25	—0.1	0.5	21	3.0	0.4
Mar. 1	0.5	0.3	25	3.2	0.1
5	1.1	—0.1	29	3.2	0.4
9	—1.7	+0.1	Apr. 2	—3.1	+0.4

From the observed differences between the two nuclei, I now obtained the normal values given below, and having applied them to the corrected tabular places of the primary nucleus, I computed, from the resulting places for the secondary, the subjoined elements: —

M. T. Greenwich.	$\alpha' - \alpha$	$\delta' - \delta$	α'	δ'
1846, Jan. 24.0	— 1′ 17″.6	+2′ 6″.6	7° 5′ 4″.0	— 1° 13′ 2″.1
Feb. 23.0	— 3 8.6	+6 4.3	39 28 1.3	— 6 30 36.5
Mar. 25.0	—11 26.5	+8 23.8	95 51 56.9	—14 18 47.9

ELEMENTS *A*.

1846, Feb. 11.0, M. T. Greenwich.

Mean Equinox, 1846.0.

M'	359° 59′ 15″.86		
Ω'	245 53 32.61	Ω'_0	327° 2′ 54″.10
ω'	223 9 11.28	ω'_0	139 37 28.18
i'	12 35 14.27	i'_0	21 27 3.90
φ'	49 12 9.64		
μ'	536″.13827		

The authorities for the observations of this nucleus, not always the same as for the primary, may be here given together.

Berlin,	*Astr. Nachr.*, XXVI. p. 3.
Cambridge (Eng.),	*Astr. Journ.*, III. p. 80.
Cape of Good Hope,	*Astr. Nachr.*, XXX. p. 103.
Dorpat,	" " XXIV. p. 39.
Geneva,	" " XXIV. p. 59; XXV. p. 117.
Greenwich,	*Greenwich Observations*, 1845.
Königsberg,	*Königsberg Observations*, XXIX.
London,	*Astr. Nachr.*, XXIV. p. 26.
Paris,	*Comptes Rendus*, XXII. p. 287.
Philadelphia,	*MS.*
Vienna,	*Astr. Nachr.*, XXIV. p. 187.
Washington,	*Washington Observations*, 1846.

The observations themselves, and the results of comparison with the above elements, are as follows: —

M. T. Greenwich.	$\alpha' - \alpha$	$\delta' - \delta$	C. — O. $\Delta\alpha'$	C. — O. $\Delta\delta'$	Place of Observation.
1846, Jan. 14.50	—66″.0	+ 69″.1	— 6″.2	+17″.4	Washington.
18.52	66.9	108.2	— 4.1	— 6.0	Washington.
19.49	64.9	106.3	— 7.3	— 0.1	Washington.
22.51	82.5	113.6	+ 6.6	+ 6.1	Washington.
.54	70.7	126.9	— 5.2	— 7.1	Philadelphia.
23.30	—77.7	+123.3	+ 0.7	+ 0.2	Cambridge, (Eng.)

M. T. Greenwich.	$\alpha' - \alpha$	$\delta' - \delta$	C. — O.		Place of Observation.
			$\Delta\alpha'$	$\Delta\delta'$	
1846, Jan. 23.52	—77″.1	+120″.8	— 0″.2	+ 3″.8	Washington.
24.29	76.6	127.3	— 1.7	+ 1.0	Cambridge, (Eng.)
.52	82.3	123.9	+ 3.7	+ 5.6	Washington.
.52	78.1	130.8	— 0.5	— 1.3	Philadelphia.
26.21	81.9	137.7	+ 0.8	+ 0.6	Königsberg.
.50	82.2	140.7	+ 0.7	— 0.9	Washington.
27.26	83.9	143.0	+ 1.1	+ 0.9	Königsberg.
.27	87.6	145.4	+ 4.8	— 1.5	Cambridge, (Eng.)
.31	85.0	146.6	+ 2.1	— 2.4	Berlin.
28.26	84.0	146.6	— 0.5	+ 2.9	Berlin.
.26	86.5	151.9	+ 2.0	— 2.4	Cambridge, (Eng.)
.29	87.8	142.1	+ 3.2	+ 7.5	Vienna.
.49	89.9	153.5	+ 5.0	— 2.7	Philadelphia.
.50	84.7	147.3	— 0.2	+ 3.5	Washington.
29.31	81.6	155.3	— 4.7	+ 0.2	Cambridge, (Eng.)
30.24	87.0	160.8	— 1.0	+ 0.4	Berlin.
Feb. 2.28	91.8	182.2	— 2.2	— 1.5	Berlin.
4.25	98.0	195.4	— 0.3	— 1.0	Berlin.
.49	93.7	191.0	— 5.1	+ 5.1	Washington.
.54	101.7	206.7	+ 2.8	—10.3	Philadelphia.
5.29	97.5	180.0	— 3.3	(+22.0)	Geneva.
.51	97.9	202.3	— 3.4	+ 1.2	Washington.
6.29	105.1	210.0	+ 1.8	— 0.6	Berlin.
.32	108.6	212.3	+ 5.2	— 2.6	Paris.
7.29	102.1	217.4	— 3.8	— 0.3	Berlin.
.31	107.5	221.1	+ 1.6	— 4.0	Greenwich.
8.31	108.9	236.4	+ 0.1	—11.4	London.
9.	86.0	233.0	(—25.8)	— 0.2	Königsberg.
.29	110.0	229.1	— 1.8	+ 3.7	Greenwich.
.50	111.6	242.4	— 0.9	— 7.7	Washington.
10.27	112.5	247.3	— 2.6	— 6.1	Geneva.
.27	113.5	245.0	— 1.6	— 3.8	Berlin.
.30	104.0	237.5	—11.2	+ 3.9	Paris.
11.31	112.6	250.3	— 6.2	— 0.2	Cambridge, (Eng.)
.54	115.8	241.6	— 3.9	+ 7.5	Washington.
12.29	123.0	260.4	+ 0.2	— 1.6	Paris.
.30	118.3	253.9	— 4.5	+ 5.0	Cambridge, (Eng.)
.30	122.7	258.8	— 0.1	+ 0.1	Geneva.
.51	119.9	270.6	— 3.7	— 9.9	Washington.
13.20	126.7	271.5	0.0	— 4.5	Dorpat.
.31	124.9	266.1	— 2.3	+ 1.9	Cambridge, (Eng.)
.52	130.0	278.4	+ 1.9	— 8.5	Washington.
14.29	133.9	279.3	+ 2.1	— 2.2	Berlin.
.30	134.6	281.8	+ 2.8	— 4.7	Königsberg.
15.23	137.0	295.8	+ 0.3	— 9.9	Dorpat.
16.26	144.3	313.2	+ 2.1	—17.6	Dorpat.
.52	144.1	305.4	+ 0.4	— 7.5	Washington.
17.29	144.6	303.2	— 3.6	+ 2.7	Geneva.
18.29	149.7	318.1	— 4.5	— 2.3	Geneva.
.29	136.0	315.5	—18.2	+ 0.3	Vienna.
.32	158.4	319.4	+ 4.0	— 3.3	Cape.
.32	143.9	316.3	—10.5	— 0.2	Berlin.
.53	149.7	317.9	— 5.9	+ 0.3	Washington.
19.28	151.6	322.9	— 8.9	+ 3.0	Geneva.
.31	164.2	333.1	+ 3.6	— 6.9	Cape.
20.29	165.0	334.0	— 2.4	+ 2.3	Geneva.
.29	163.8	342.0	— 3.6	— 5.7	Cape.
.30	158.6	351.2	— 8.9	—14.5	Königsberg.
21.26	178.3	348.3	+ 3.5	— 1.7	Vienna.
.52	176.4	354.5	— 0.3	— 5.2	Washington.
22.27	173.6	355.7	— 9.3	+ 1.6	Vienna.
.29	—183.3	+360.6	+ 0.2	— 3.1	Geneva.

M. T. Greenwich.	$\alpha' - \alpha$	$\delta' - \delta$	C. — O. $\Delta\alpha'$	$\Delta\delta'$	Place of Observation.
1846, Feb. 22.51	—181″.8	+364″.5	— 3″.1	— 4″.7	Washington.
.55	191.4	353.1	+ 6.1	+ 7.1	Philadelphia.
24.28	197.0	364.8	— 4.3	+13.9	Vienna.
.34	165.0		(—36.9)		Greenwich.
.35	203.9	380.7	+ 1.9	— 1.3	Cambridge, (Eng.)
25.30	209.9	391.4	— 1.9	— 1.8	Cambridge, (Eng.)
.32	232.3	435.0 (1)	(+20.2)	(—45.2)	Cape.
26.28	220.7	402.1	— 2.2	— 1.9	Berlin.
.31	219.4	395.3	— 3.7	+ 5.2	Geneva.
.54	222.6	410.1	— 3.3	— 7.1	Washington.
27.28	232.1	416.1	— 2.9	— 5.1	Berlin.
.33	229.5	415.1	— 6.2	— 3.5	Cambridge, (Eng.)
28.30	250.0		+ 1.9		Greenwich.
.31	250.8	427.9	+ 2.6	— 5.9	Cambridge, (Eng.)
Mar. 2.27	264.6	447.8	—10.8	— 5.1	Berlin.
.34	270.0		— 6.4		Greenwich.
.34	276.0	415.2	— 0.4	— 1.8	Cambridge, (Eng.)
3.32	273.6	456.5	—17.3	— 3.1	Geneva.
.58	292.1	446.2	— 2.7	+ 9.8	Washington.
4.29	302.2	466.4	— 3.9	— 3.3	Berlin.
.59	309.9	491.9	— 0.9	(—25.8) (2)	Washington.
5.	319.7	461.8	— 2.0	+10.6	Königsberg.
.32	319.3	476.2	— 3.6	— 3.1	Cambridge, (Eng.)
.33	315.0		— 7.9		Greenwich.
.57	337.5	488.0	+10.6	—12.5	Washington.
7.31	368.8	506.7	+11.1	—15.2	Berlin.
8.56	378.7		— 2.1		Washington.
10.56	408.9		—11.6		Washington.
14.57	493.5	550.9	—10.3	—15.8	Washington.
16.34	531.6	526.4	— 5.7	+11.9	Geneva.
19.31	593.5	542.3	— 5.4	— 6.8	Geneva.
20.30	622.9	533.8	+ 6.0	— 1.4	Berlin.
.37	617.9	518.0	— 0.3	—15.8	Cambridge, (Eng.)
21.32	629.6	522.9	— 4.9	+ 5.2	Geneva.
.58	646.5	525.3	+ 7.6	+ 1.6	Washington.
22.33	646.8	504.9	— 3.9	+17.8	Geneva.
25.37	693.9	507.1	+ 3.3	— 6.4	Cambridge, (Eng.)
27.38	—710.5	+482.4	+ 2.0	— 0.8	Cambridge, (Eng.)

This representation of observations might have been still closer, but unfortunately I forgot, while preparing the normals, to correct them for perturbation. The correction by equations of condition, however, is very easily effected, since the coefficients may safely be assumed the same as for the primary nucleus. I prepared, therefore, the following five normals: —

	$\Delta\alpha' . \cos\delta'$	No. Obs.	$\Delta\delta'$	No. Obs.
1846, Jan. 24	0″.0	22	+0″.4	21
Feb. 9	—1.9	22	—1.6	22
17	—2.7	19	—4.1	19
25	—2.0	19	—1.2	17
Mar. 13	—2.0	21	—1.6	17

The solution of the equations gave

$$\begin{aligned} \Delta M' &= +0''.110 + 2.494 . \Delta\mu' \\ \Delta \text{☊}'_0 &= +0.208 + 38.327 . \Delta\mu' \\ \Delta\omega'_0 &= -1.538 - 29.617 . \Delta\mu' \\ \Delta i'_0 &= +1.009 + 4.503 . \Delta\mu' \\ \Delta\varphi' &= -0.448 - 94.332 . \Delta\mu' \end{aligned}$$

$$\begin{aligned} nn . 6 &= 11''.9898 - 0.11692 . \Delta\mu' + 0.00053 . \Delta\mu'^2 \\ &= 5.5416 + 5.3 \{\Delta\mu' - 1''.10302\}^2 \end{aligned}$$

Assuming $\Delta\mu' = +1''.10302$, we have

ELEMENTS *B.*

M'	359° 59′ 18″.72 + 2.494 $\Delta\mu'$		
$\text{☊}'_0$	327 3 36.58 +38.327 $\Delta\mu'$	$\text{☊}'$	245° 54′ 7″.80
ω'_0	139 36 53.97 —29.617 $\Delta\mu'$	ω'	223 8 42.21
i'_0	21 27 9.88 + 4.503 $\Delta\mu'$	i'	12 34 59.48
φ'	49 10 25.14 —94.332 $\Delta\mu'$		
μ'	537″.24129 + $\Delta\mu'$		

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(1) The probability of an error of 1′ in observed δ of primary nucleus is again suggested. Compare *A. N.*, XXIV. p. 182.

(2) But one comp. in δ.

And substituting the adopted corrections in the equations, we obtain

	$\Delta\alpha'.\cos\delta'$		$\Delta\delta'$	
1846, Jan. 24	0″.0	—0.63 . $\Delta\mu'$	+0″.3	—1.35 . $\Delta\mu'$
Feb. 9	+0.4	+0.78 . $\Delta\mu'$	+0.3	+0.40 . $\Delta\mu'$
17	—0.4	+0.39 . $\Delta\mu'$	—1.7	+0.74 . $\Delta\mu'$
25	+0.2	—0.09 . $\Delta\mu'$	+1.3	+0.70 . $\Delta\mu'$
Mar. 13	0.0	—0.16 . $\Delta\mu'$	—0.2	—0.81 . $\Delta\mu'$

§ 6.

The remarkable resemblance between these last elements and those found above for the primary nucleus suggests the question how far the whole amount of observed difference in R.A. and Decl. may be represented by a variation of M alone. We find, on the one hand, that this resemblance may be made even closer without materially affecting the residuals; for assuming, in the last solution, $\Delta\mu' = \mu - \mu' = +0''.86712$, instead of the value there adopted, and substituting the right-ascensions of the perihelion for the angles ω_0 and ω'_0, we obtain

	Elements B*.	B* — III	Residuals. $\Delta\alpha'.\cos\delta'$	$\Delta\delta'$
M	359° 59′ 18″.13	—44″.73		
Ω'_0	327 3 27.54	—13.20	+0″.2	+0″.6
π'_0	106 40 28.50	— 2.10	+0.2	+0.2
i'_0	21 27 8.81	+ 0.18	—0.5	—1.9
φ'	49 10 47.39	— 1.83	+0.2	+1.2
μ'	537″.00539	0.0	0.0	+0.1

Sum of squares of residuals, Elements B = 5″.16
" B* = 5.83

On the other hand, we have for the coefficients of ΔM, and the corresponding normal values of the differences in right-ascension and declination of the two nuclei, —

	$a.\sec\delta$	$\alpha' - \alpha$	a	$\delta' - \delta$
1846, Jan. 24	1.936	— 77″.9	— 2.840	+126″.6
Feb. 9	2.610	109.0	5.261	232.2
17	3.394	143.8	6.907	307.0
25	4.819	206.7	8.786	387.6
Mar. 13	10.598	—469.0	—11.933	+531.0

The value —43″.85, assumed for ΔM, will give the following residuals: —

	$\Delta\alpha'$	$\Delta\delta'$
Jan. 24	—7″.0	—2″.1
Feb. 9	—5.4	1.5
17	—5.0	4.1
25	—4.6	2.4
Mar. 13	+4.3	—7.8

which of course cannot be considered as errors of observation. And, moreover, the observations obtained by Secchi in 1852 (1) show that some change of μ also is required, for with a small coefficient of ΔM the differences of the geocentric places are much greater than in 1846. But the farther prosecution of this subject, as involving a discussion of the observations in 1852, must be deferred for the present.

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(1) *Astr. Nachr.*, XXXV. p. 251.

OBSERVATIONS OF MASSALIA AND LUTETIA,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury.]

[Corrected for refraction.]

MASSALIA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑳ — * Δα	⑳ — * Δδ	⑳'s apparent α	⑳'s apparent δ	A.
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
1852, Oct. 19	9 4 18.2	12	Weisse XXIII. 1039	—3 29.11	— 4 50.53	23 47 3.77	—1 1 53.85	10
20	8 8 15.3	7	"	—4 2.99	— 8 53.76	46 29.90	1 5 41.30	10
21	8 13 30.5	8	*a*	—1 22.59	— 3 53.22	45 56.33	1 9 48.33	10
23	7 43 48.4	10	"	—2 25.09	—11 27.43	44 53.79	1 17 22.61	10
24	8 26 47.3	6	"	—2 54.90	—15 7.89	44 23.98	1 21 3.03	10
25	8 3 44.7	6	Weisse XXIII. 817	+3 47.73	+10 18.62	43 57.21	1 24 27.29	10
Nov. 7	8 19 14.5	6	" 817	+0 27.85	—16 44.24	40 37.33	1 51 30.84	8
	8 10 52.4	5	" 830	—0 2.89	—15 58.63	40 36.44	1 51 29.99	8
9	7 43 51.2	12	" 817	+0 22.48	—17 59.53	40 31.69	1 53 0.91	10
Dec. 1	6 55 56.7	5	" 916	+2 5.44	+20 30.43	47 15.34	1 17 11.59	10
15	7 17 7.3	6	" 1267.	—3 27.48	— 4 38.53	57 52.06	0 12 19.53	10
	8 14 27.5	2	" 1267	—3 25.49	— 4 26.30	57 54.06	0 12 7.30	10
17	6 48 45.6	8	" 1267	—1 37.30	+ 6 44.63	23 59 42.23	—0 0 56.51	10
18	8 4 12.0	6	" 1267	—0 36.60	+13 3.84	0 0 42.91	+0 5 22.63	10
1853, Jan. 19	7 42 4.9	6	Weisse O. 647	+2 26.45	—10 54.10	0 39 53.18	4 11 33.08	10
	8 51 26.8	3	"	+2 31.04	—10 27.51	0 39 59.78	4 11 59.76	10
Feb. 14	7 42 4.9	5	(2)	+0 54.39	+ 6 20.80	1 21 7.18	8 22 18.67	8
17	7 12 51.5	10	Weisse I. 410	+2 7.91	—21 15.58	1 26 16.44	8 52 22.85	9
20	7 58 57.3	4	" 598	—1 55.17	+ 0 58.28	1 31 32.65	9 23 1.50	10
25	7 51 28.5	10	" 713	+0 56.32	+ 0 52.49	1 40 28.89	10 13 46.45	10
26	7 9 23.3	20	" 767	—0 48.63	+ 4 57.53	1 42 14.27	10 23 40.49	10
Mar. 5	7 19 42.1	14	" 969	+0 54.87	+ 6 24.17	1 55 7.55	11 34 26.62	10
6	7 10 32.9	7	" 972	+2 29.04	—13 55.76	1 56 59.01	11 44 27.39	10
(1) 14	7 27 10.5	7	Weisse II. 144	+2 7.45	+19 40.89	2 12 15.31	13 4 20.13	4
15	7 20 1.6	10	" 209	+0 41.62	— 1 7.38	2 14 10.77	+13 14 14.27	10

(1) Very high wind.

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.	No. of Comp.
		h. m. s.	° ′ ″		
Weisse XXIII. 1039	9	23 50 24.31	—0 57 43.40	Weisse's Catalogue.	
a	9	23 47 10.37	1 6 50.92	Equatorial (from preceding star).	7
Weisse XXIII. 817	7	23 40 1.00	1 35 41.33	Weisse's Catalogue.	
" 830	8	23 40 30.85	1 36 26.24	Mean of Weisse and Lamont.	
" 916	9	23 45 1.70	1 38 36.36	Weisse's Catalogue.	
" 1267	7	0 1 11.41	—0 8 34.07	Mean of Weisse and Santini.	
Weisse O. 647	8	0 37 20.74	+4 21 35.56	Weisse's Catalogue.	
Weisse I. 336	9	1 19 53.02	7 59 58.03	"	
(2)	9	1 20 4.53	8 15 8.85	Equatorial (from preceding star).	10
Weisse I. 410	8	1 21 0.04	9 12 49.81	Weisse's Catalogue.	
(1) " 598	9	1 33 19.67	9 21 15.49	Σ 146 Catalogue General.	
" 713	9	1 39 24.15	10 12 6.77	Weisse's Catalogue.	
" 767	7.8	1 42 54.78	10 17 56.12	"	
" 969	9	1 54 4.50	11 27 16.70	"	
" 972	7	1 54 21.79	11 57 37.36	"	
Weisse II. 144	8	2 9 59.50	12 44 2.16	"	
" 209	9	2 13 20.75	+13 14 44.10	"	

(1) Struve's determination is of Weisse 600. —— 598 is reduced from it, with Bessel's, Struve's, and the observed difference.

LUTETIA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉑ — ∗ Δα	㉑ — ∗ Δδ	㉑'s apparent α	㉑'s apparent δ	A.
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
March 24	8 16 8.7	7	Bessel's Zones 391	+0 49.02	+ 0 49.12	3 57 8.65	+20 27 50.07	5
29	8 18 18.9	10	" 393	—1 50.81	— 0 37.89	4 5 3.68	20 53 41.07	9
April 2	9 15 6.3	4	" 393	+0 44.60	—11 4.41	4 11 38.28	21 13 43.26	8
5	8 4 40.5	12	" 393	+1 0.30	+ 4 23.27	4 16 30.23	21 27 51.25	10
10	7 55 5.5	5	" 393	—1 59.31	+ 7 46.10	(4 24 51.54)	21 50 30.78	10
	8 2 10.8	12	" 393	+0 0.92	— 5 2.30	4 24 52.72	+21 50 31.46	11

During these observations the planet was like a star of the 13.14 magnitude.

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

∗	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Bessel's Zones 391	9	3 56 10.33	+20 26 34.09	Bessel's Zones.
" 393	9	4 6 45.16	20 53 52.23	
" 393	7	4 10 44.33	21 24 21.75	
" 393	7.8	4 15 20.58	21 23 3.10	
" 393	9	4 24 42.35	21 55 11.48	
" 393	8.9	4 26 41.43	+21 42 22.02	

NEW WORKS.

Astronomische Beobachtungen auf der Sternwarte der Königlichen Rheinischen Friedrich-Wilhelms Universität zu Bonn angestellt und herausgegeben von Dr. Fr. W. A. Argelander. *Zweiter Band. Zonenbeobachtungen am Südhimmel. Zweiter Abtheilung.* Bonn, 1852. — This is the second division of the observations between 15° and 31° of South Declination, instituted by Professor Argelander at Bonn. The publication of the first half was announced on page 55 of this volume of the *Astronomical Journal*, and it has been speedily followed by the remaining zones.

Prefixed to the present division are a minute account of the instrument and the arrangement of the observations; a discussion of the sources and limits of error in determining right-ascensions and declinations, an explanation of the construction and use of subsidiary tables for reduction to mean places, a table of reductions of the places of frequently observed stars to the mean equinox of 1850.0, together with chapters upon the estimation of magnitudes and upon the double stars which occur.

In the whole series of these zones are contained 23,250 observations, — of which Professor Argelander allows about 5,500 for repeated observations of the same star, leaving 17,600 different stars, the places of which are now determined with ample precision for future recognition. In the northern and southern zones of Argelander are comprised observations of both coördinates of about 40,000 stars, obtained by the examination of more than 11,000 square degrees.

The whole system of zones, namely, Bessel's, in observing which Argelander took part, together with Argelander's two series, covers almost precisely three quarters of the entire heavens, giving us the positions of more than 100,000 stars where not more than one half this number were previously known.

In the southern zones are contained the places of

1607	stars	of 9.10	magnitude.
8322	"	" 9	"
5482	"	" 8.9	"
3377	"	" 8	"
1554	"	" 7.8	"
1855	"	" 7	"
388	"	" 6.7	"
374	"	" 6	"
1174	"	brighter than 6 magnitude.	
17	"	whose magnitude was not noted (chiefly 9).	

Beobachtung der totalen Sonnenfinsterniss vom 28sten Juli 1851, *zur Rastenburg in Ostpreussen. Auf Veranlassung der königlichen Sternwarte zu Bonn angestellt von dem Gehülfen derselben* J. F. Julius Schmidt. Bonn, 1852. — This careful and minute description of the important total eclipse of 1851, prepared with the well-known fidelity of Mr. Schmidt, is accompanied by four beautifully lithographed plates, representing the appearances at different moments of time. The observations were made at Rastenburg in East Prussia; longitude, 3m. 25s..03 East from Königsberg; latitude +54° 4′ 55″.7.

G.

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On the Orbit of Biela's Comet in 1845–46, by Professor J. S. Hubbard.
Observations of Massalia and Lutetia, made with the Filar-Micrometer of the Washington Equatorial, by Mr. James Ferguson.
New Works.

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SEMIDIAMETER OF THE SUN, INVESTIGATED FROM GREENWICH OBSERVATIONS.

By JOSEPH WINLOCK.

[In a Report to Lieutenant Davis, Superintendent American Ephemeris. Published by Authority of Hon. James C. Dobbin, Secretary of the Navy.]

I have the honor to submit some results of an investigation, the object of which was to determine, for the use of the *American Ephemeris* under your direction, the semidiameter of the sun from observations made at the Observatory of Greenwich.

The series of observations made by Bradley and Maskelyne with Bird's quadrant, and that with the mural-circles of the Greenwich Observatory from 1836 to 1851, have been examined.

In reducing the quadrant observations, Bessel's values for the refraction were applied, using the arithmetical mean between the indications of the internal and external thermometer. The observations of the limbs were not reduced separately; but the corrections were applied to the differences between the zenith-distances of the upper and lower limbs, using the readings of the exterior divisions of the quadrant only.

The fractions of a second less than one half, which are denoted in the printed observations by the signs +, —, &c., were at first neglected. Subsequently their effect upon the mean of the whole series was estimated, and found to be inappreciable. The observed diameters were compared with the value 32′ 1″.80 of the diameter of the sun at the mean distance of the earth, deduced by Bessel from 1698 observations with Reichenbach's circle (*Tabulæ Regiomontanæ*, 1830 L.).

For the computation of the diameters with which the observations were compared, a table was constructed with the above mean value of the diameter, and the log. of the earth's radius-vector taken from Carlini's solar tables in the *Effemeridi Astronomiche di Milano* for 1833. This gave the diameter corresponding to the day of the year + A (the argument of Table XIX. of Carlini's tables).

A correction for the perturbation of the earth's radius-vector was applied to each computed diameter by means of a small auxiliary table, constructed for the purpose.

The errors of adjustment of the instrument were found too small to have any important effect on the observed diameters.

I divided Bradley's observations into three groups; the first consisting of 484 observations, from August 5, 1753, to November 7, 1756; the second, of 535, from November 7, 1756, to May 15, 1760; and the third, of 262, from the latter date to July 16, 1762. I rejected several which exhibited very large errors; others were rejected by Professor Peirce's *Criterion for the Rejection of Doubtful Observations* (*Astr. Journ.*, Vol. II. p. 161). I also overlooked several, which I did not think of sufficient importance to reduce afterwards, as their effect upon the mean of so great a number must be very small.

The observations rejected are those of

1753, Aug. 21
Oct. 31
1754, Feb. 21
July 20
Aug. 1
1755, May 8
June 14
1755, June 22
July 15
Nov. 10
" 24
1756, May 11
" 15
July 13
1756, Oct. 7
Nov. 7
1759, April 23
June 16
1760, July 23
1761, Mar. 21.

Those overlooked are, —

1753, Aug. 6
" 9
Oct. 22
1754, Sept. 14
1754, Sept. 22
" 23
" 24
" 25
1754, Sept. 26
" 27
1757, Mar. 5.

The probable error of a single observation was determined from the arithmetical mean of the residual errors, instead of that of their squares, according to the method used by Bessel (*Fundamenta Astronomiæ*, p. 18).

Allowing equal weight to each observation, the first group gave

$\varepsilon =$ Error of Bessel's value of diameter, $-1''.27$

$r =$ Probable errors of single observation, 1.72

with the following distribution of errors : —

481 observations.

	Number of Errors	
	by Calculation.	by Observation.
Between 0″ and 1″	147	151
“ 1 “ 2	127	125
“ 2 “ 3	93	87
“ 3 “ 4	60	59
“ 4 “ 5	32	34
“ 5 “ 6	16	13
“ 6 “ 7	6	11
Greater than 7	3	4

The second group gave

ε . . . . —4″.72
r 1.70

with the following distribution of errors : —

535 observations.

	Number of Errors	
	by Calculation.	by Observation.
Between 0″ and 1″	164	148
“ 1 “ 2	140	131
“ 2 “ 3	101	108
“ 3 “ 4	65	70
“ 4 “ 5	35	41
“ 5 “ 6	15	11
“ 6 “ 7	7	16
Greater than 7	5	10

The third group gave

ε . . . . —6″.32
r 2.76

If all the observations of this group made before 1761 are combined with the second, the error of Bessel's value obtained from the second will be —4″.78, instead of —4″.72.

The remainder of the third group appears to be so defective, that it did not seem worthy of very careful examination. The difference, 3″.5, between the values of the diameter as obtained from the first and from the second group is so large, that we must infer that a change either of observers or of the method of observing or of correcting for the thickness of the wires was made, about the latter part of the year 1756 or the beginning of 1757, although I can find no mention of any such change. The good distribution of errors shows that the method of least squares is applicable to the separate portions, and consequently that it is not probable that any important change was made except at about the time designated.

Maskelyne's observations were made with the same instrument. The object-glass of the telescope was changed August 7, 1772.

With the old glass, 270 observations, between May, 1765, and March, 1767, gave

ε = ... —6″.11 ± .15
270 from Jan., 1770, to Feb., 1772, gave —4.40 ± .15

94 marked W. B., the initials of an assistant, gave

ε = ... —6″.59
r = ... 2.10

34 marked D. gave

ε = ... —6″.19
r = ... 1.84

With the new glass, 1,000 observations from August, 1772, to August, 1781, gave

ε = ... —2″.86
r = ... 2.50

780 from August, 1781, to January, 1789, gave

ε = ... —1″.94

The largest value of ε given by any group of 90 observations within the latter limits was = ... —3″.43

The least, ... +0″.12

Those portions of the series which have been examined appear to consist of two or more different kinds of observations, each giving different measures of the diameter, but so intermingled that they cannot be separated without more information in regard to them than is given in the introduction to the first volume of the observations.

It seems that nothing important can be inferred from the whole series, except that measures made at different times with the same instrument exhibit discrepancies as great as those which astronomers are accustomed to attribute to difference of irradiation of lenses.

Lindenau (Zach's *Monatliche Correspondenz*, Vol. XIX. p. 529, and Vol. XXI. p. 469) has reduced a large number of Bradley's and Maskelyne's horizontal measures, and also some of Maskelyne's vertical measures, of the sun's diameter from 1787 to 1798. From these he infers that the horizontal is 2″.36 less than the vertical semidiameter. The horizontal semidiameter, which he obtains from Bradley's transit-observations, instead of being 2″.36 less, is a little greater than the vertical semidiameter which I have found from the quadrant-observations made at the same time ; and the mean of the values of the horizontal semidiameter which he deduces from Piazzi's, Bradley's, and the first period of Maskelyne's observations (*Monatliche Correspondenz*, Vol. XXI. p. 477), differs only 0″.04 from the vertical semidiameter which I obtained from the first group of Bradley's observations.

The difference between the horizontal and vertical semidiameter, as deduced from the observations of several different astronomers, is curiously consistent.

Vertical semidiameter from first group of Bradley's quadrant-observations, ... 16′ 1″.54
Horizontal semidiameter from Bradley's transit-observations, Lindenau (*Monatliche Correspondenz*, Vol. XXI. p. 477), ... 16 1.86
Difference, ... —0.32

Struve (*Astr. Nachr.*, Vol. III. p. 18), found this difference,	—0″.51
Bessel (*Ibid.*),	—0.14
Greenwich observations from 1836 to 1845 give	—0.44
Edinburgh observations, 1840,	—0.53
Professor Hubbard, with the Washington Meridian-Circle,	—0.51

The series of observations made with the Greenwich mural-circles from 1836 to 1851 presents irregularities similar to those which have been noticed in the observations of Maskelyne.

If the mean of the differences between the observed and computed diameters for each year, which are given in the introductions to the volumes of Greenwich Observations, be taken as so many independent determinations of the error of Bessel's value, and combined as 15 observations of equal weight, the probable error of the mean of one year will be found to be 0″.34. That is, the mean of 108 observations will have a weight about equal to that of 10 of Professor Coffin's observations with the Washington mural-circle; and applying *Peirce's Criterion*, the mean of the year 1847 would be rejected, and that of 1838 would fall below the limit of rejection only 0″.05 If, instead of the above great probable error, one be deduced from the observations of any one year, the means of both 1838 and 1847 would be rejected, — their errors greatly exceeding the limit.

If the whole series be divided into three parts, the first consisting of the observations made with two circles working together from January 1, 1836, to February 26, 1839; the second, of those with Troughton's circle alone, from February 26, 1839, to August 21, 1843; the third, of those made between January 1, 1844, and January 1, 1851; — the first, consisting of 370 observations, will be found to give

$$\varepsilon = \ldots\ldots -1''.61$$
$$r = \ldots\ldots 1.45$$

The second, containing 500 observations,

$$\varepsilon = \ldots\ldots -1''.44$$
$$r = \ldots\ldots 1.45$$

The third, containing 707 observations,

$$\varepsilon = \ldots\ldots -2''.04$$
$$r = \ldots\ldots 1.73$$

1853, *May* 23.

Hence it is evident that the method of least squares is not applicable to the whole series; a part of the observations at least being affected by constant errors not subject to the law of probabilities.

In order to account for this, I examined, at the suggestion of Professor Peirce, the observations of each observer separately, and found that each gave a different diameter, and that their observations were of unequal value.

The subjoined table contains the values of ε and r from the observations of several of the principal observers who used the mural-circles. It will probably account for the inconsistency mentioned above.

Observer.	ε	r	No. of Obs.
H.	—2″.61	1″.65	50
H. B.	—1.33	1.16	50
F.	—0.47		7
E.	—2.55	1.39	50
R.	—1.05	1.33	50
G.	—1.83	1.16	50
J. H.	—0.46		4
D.	—0.98	1.52	35
W. R.	—3.19	1.24	50
P.	+0.37	1.90	28

From this investigation, I think it may be inferred that the discrepancies which exist in the values of the diameters of the sun and of the planets, deduced from the observations of different astronomers, are owing partly to difference of instruments and partly to the observers themselves. Much of the difference between observers may be due to their methods of using the wires. In some cases, their thickness may not be wholly eliminated.

The results seem corroborative of the conclusions of Plateau and others, which attribute much of the enlargement of the disc to the physiological peculiarities of the eye of the observer, and are at variance with the theory of irradiation communicated to the Astronomical Society in 1849, by Professor Powell.

The comparisons of Bradley's observations with Bessel's value are subjoined, in order that astronomers may combine them in a different manner from that which I have adopted, if it should be thought desirable. The column C. — O. contains the differences between calculation and observation.

Note. — Since this article by Professor Winlock has been in type, I have seen, in a recent number of the *Comptes Rendus* of the French Academy, a report by Mr. Mauvais upon a memoir of Mr. Goujon in which the latter astronomer has been led to similar results by the discussion of other observations. It seems therefore proper for me to state, that the chief results given in the foregoing article were orally communicated to the American Academy by Professor Winlock in December last, and that the article in its present form was handed me for publication May 23d, but has been delayed by precedence of other matter.

G.

COMPARISON OF BRADLEY'S OBSERVATIONS.

		C. — O.
1753, Aug. 5		— 1″.51
14	Cloudy	+ 1.08
15		— 0.62
18		— 1.50
20		— 2.78
21	Cloudy ::	+11.63 .
22	:	+ 6.53
21		+ 1.35
25		— 5.22
26		— 1.79
28		— 3.44
29	Clouds :	+ 3.54
30		— 1.06
31	::	+ 4.91
Sept. 1		— 2.60
4	Cl. ::	+ 5.31
6		— 3.68
8	Cl.	+ 0.80
10		— 7.17
11		+ 1.32
12		— 0.70
13	Cl.	— 1.21
14		— 4.71
15		+ 2.80
16	Cl. ::	— 1.18
17		— 5.69
18		— 1.18
19		— 0.15
20		— 7.15
21		— 2.14
23		+ 4.90
25		— 3.09
26		— 1.06
27		— 7.04
29		— 1.96
Oct. 1		— 0.95
2	Clouds	+ 1.61
6		— 1.79
7		— 7.69
8		— 1.70
13		— 0.56
17	Cl.	+ 3.23
20		+ 5.11
28	Clouds	— 2.78
31	:	+ 9.84 .
Nov. 1		— 2.98
3		+ 2.32
6		— 4.95
8	Cloudy	— 0.73
11	Hazy and Cl. ::	+ 5.39
13	:	+ 0.81
16		+ 0.84
17		— 1.98
19		— 2.13
20		— 1.27
21		— 0.12
21		— 0.89
29		— 2.69
Dec. 3	Clouds	+ 0.64
8		— 1.70
18		— 1.97
26		— 3.32
1753, Dec. 27		— 3″.38
28		— 1.05
29		— 2.62
30		— 3.58
31		— 3.49
1754, Jan. 2		— 2.88
7		— 5.50
9		— 4.49
12		+ 0.63
15		+ 0.66
18		— 1.22
19		— 1.03
23		+ 1.88
25		— 2.93
26		— 2.58
27	Cl.	— 3.12
31	Clouds	— 0.28
Feb. 1		+ 3.71
6		— 3.24
7		— 1.10
11		+ 1.41
14		+ 2.20
16	Hazy	+ 2.04
18		+ 0.85
19		— 2.21
20		+ 2.54
21		—16.22 .
22		— 4.78
23	Cl.	— 2.24
24		— 2.21
Mar. 1		— 2.50
3		— 1.59
4	Cloudy	— 2.09
12		— 2.96
19	Cloudy	— 1.17
22		— 2.76
28		— 3.94
31	Cloudy	— 3.00
April 2	Cloudy	— 0.94
3	Cloudy	— 2.08
5	Cloudy ::	+ 0.89
6		— 1.61
8		— 2.70
9		— 4.74
12		— 2.81
14		— 0.38
15	Cloudy	— 2.44
18		— 2.40
20	Clouds	+ 2.47
22		— 5.51
23		— 2.02
30		— 4.27
May 1		— 3.73
3		— 3.58
4		— 3.52
5		+ 2.06
6		— 2.38
11		— 4.95
19		— 3.53
20		— 6.68
22	::	+ 2.50
28		— 2.83
1754, May 29		— 4″.60
31	Cloudy	— 1.60
June 2		— 1.57
4	Cloudy	— 4.54
7	Clouds	— 0.19
14	Cloudy	+ 1.57
15		— 4.09
20		— 2.17
23		— 2.87
25		— 2.46
26		+ 1.01
28	Hazy	+ 2.48
30		+ 0.48
July 2		— 2.02
4		— 0.45
6	Clouds	+ 0.13
11		+ 0.96
14		— 1.75
16	Cl.	— 3.02
18		— 2.24
20		
21		+ 0.72
22		— 2.50
29		— 0.47
30		+ 1.29
31	Clouds	— 4.43
Aug. 1		+ 7.92 .
2		— 2.89
8		+ 1.39
9		— 3.28
10	Cl.	— 0.50
11		— 3.18
12	::	+ 2.14
14		— 1.60
15		— 4.30
18		— 3.19
19		— 4.31
20		— 4.39
22		— 0.57
23		— 1.63
25		+ 2.74
26		+ 0.19
27		— 0.89
29		— 3.99
31	Hazy	+ 3.43
Sept. 3	Cl.	+ 3.29
6		+ 0.30
7	Clouds	+ 3.72
9		— 1.83
11		— 0.40
13		— 0.92
15	Cloudy	— 3.91
21		+ 1.71
28	:	— 7.04
29		— 0.54
30		— 3.00
Oct. 1		— 0.96
3		+ 0.78
4		— 1.44
7	Clouds	— 2.33
8		— 1.39
11		— 0.39

		C. − O.
1754, Oct. 12		+ 1″.15
13	Clouds	+ 2.16
14		+ 0.08
15		+ 1.54
18		+ 1.60
21		+ 6.58
22		+ 2.07
24		− 5.47
26		+ 0.46
27	Strong S.W. wind	− 1.62
28		− 1.11
29	Hazy	+ 0.27
Nov. 4		− 2.46
5	::	− 1.11
6		− 1.73
9	Cl.	+ 2.98
10		+ 2.93
11		− 2.84
12		+ 0.40
13		− 1.79
14		− 0.08
15		− 2.67
16		− 1.56
17		− 2.67
18	Cl. ::	+ 6.13
19	Cl.	− 8.17
20		− 0.69
24		− 1.12
25		+ 0.03
26		− 2.94
28		− 2.20
29		− 2.30
Dec. 3		− 0.30
4		+ 1.20
5		+ 3.47
7		− 2.04
8		− 0.47
10		− 0.76
12		− 1.34
14		− 1.57
15		+ 0.69
17		− 0.42
18		− 2.87
19		+ 2.13
25	Cloudy	+ 3.19
1755, Jan. 4		− 3.45
6	::	+ 3.59
8	Cl. ::	+ 1.91
10		− 1.53
12	Cl. ::	+ 0.33
13		+ 0.20
22		− 1.38
23		− 0.50
Feb. 2		+ 3.06
3	Cl.	+ 0.31
4		− 2.90
5		+ 0.65
8		− 2.70
11		− 0.65
12		− 2.95
14		− 4.66
17		− 0.61
18		− 0.03
Mar. 4	Cloudy	− 2.83
1755, Mar. 15	Cloudy	+ 3″.27
16		+ 4.15
17		− 2.36
23	Clouds	− 2.44
29		+ 1.36
30		− 2.20
April 1		+ 3.76
4	Cloudy	− 4.92
6	Very windy	− 2.00
7		− 1.55
14		+ 1.26
17		+ 3.27
19		− 3.24
22	Cloudy	− 0.69
27		− 0.65
May 1		+ 2.48
4		− 1.41
5		− 4.36
8	Cloudy	−14.74 .
11	Cloudy	− 2.90
12		− 3.30
18	Cloudy	− 3.01
20		− 4.72
21	Cloudy	− 4.02
23		− 2.17
27		− 3.90
28		− 3.67
29		− 1.47
June 1		− 1.76
2		− 3.59
3		− 3.79
4		− 3.54
5	Hazy	+ 0.75
7		+ 2.28
8		− 1.41
10		+ 1.22
14	Cloudy	+12.61 .
16	Cloudy	− 0.16
18		+ 0.14
19		− 1.96
20		− 4.05
22		−15.20 .
23		− 4.26
24		− 3.32
25		− 2.39
26		− 4.95
27	Cloudy	+ 4.51
28	Cloudy :	+ 3.48
July 3	Cloudy	− 2.56
4		− 3.57
6		− 1.51
11	Cloudy	− 0.65
12	Cl.	− 3.06
13		− 0.44
14		− 3.31
15		−14.19 .
16	Cl.	− 4.06
17	Clouds	+ 4.10
19		− 1.07
27	Cl.	+ 1.00
28	Cl.	− 3.81
30	Clouds	− 3.17
31	Cloudy	− 2.59
Aug. 1		− 2.37
1755, Aug. 2		− 3″.07
10		− 4.19
11		− 3.85
12		− 4.98
17		− 1.64
20		+ 0.05
22	Cl.	− 0.15
25	Cloudy	− 2.38
27		− 1.60
Sept. 1	Cl. :	+ 1.15
2		+ 3.08
5	Cloudy	− 1.02
6	Cloudy	+ 4.93
7		− 3.57
9	Cloudy :	+ 3.94
10	Cloudy	− 1.60
13		+ 1.93
15		+ 9.46 :
16		− 1.48
17		− 2.45
18	Cloudy	− 2.96
21		− 2.38
23		+ 2.16
28		− 4.27
30		+ 0.73
Oct. 1	Clouds	− 0.72
2		+ 0.26
4		− 1.21
10	Cloudy	− 0.08
12	Cloudy ::	+ 5.95
13		− 0.02
15	Cloudy	− 2.99
18		+ 3.47
23		− 4.67
25		+ 2.17
26		− 1.73
Nov. 3	Cloudy	− 1.77
5		− 0.68
6	Cloudy	+ 4.18
7		− 0.45
9		+ 1.80
10	Foggy ::	
11		− 3.11
12		− 2.46
15		− 0.69
18		− 1.18
22	Clouds	− 3.90
23		− 4.66
24		−11.83 .
26		+ 0.43
Dec. 1		− 3.29
2		− 1.71
4		− 0.39
5		− 0.44
6		− 1.60
7		− 0.36
10	Cl. :	− 2.47
13		− 4.87
15		− 0.01
16		+ 0.74
18		− 1.49
20		− 0.88
21		− 2.38
22		− 2.90

		C. — O.
1755, Dec. 24	Foggy	— 1″.43
25		— 2.21
28		— 3.34
29		— 4.16
1756, Jan. 7		— 1.14
8		— 0.81
16		— 3.98
17		— 1.57
18		— 3.42
20		— 0.64
21	Hazy :	+ 2.26
26		— 3.41
27		— 2.08
28	Cloudy	+ 0.82
Feb. 5		+ 1.29
7	Cloudy	— 3.54
10	:	— 2.14
11		— 1.01
15		— 1.92
16		+ 2.77
17		— 0.38
19		+ 0.74
22		— 4.50
23		— 4.82
27	Cloudy	— 2.66
28		+ 5.05
Mar. 9	Cloudy :	— 4.16
12	Cloudy	+ 2.87
15		— 3.16
16		— 1.17
17		— 0.67
18	Cloudy	— 1.19
20	Cloudy	— 1.25
22	Very windy	— 1.31
April 6		— 3.91
11		— 2.44
12	Cloudy	+ 0.52
14		— 6.00
21	:	— 2.62
22		— 0.62
25		+ 0.90
May 5		— 3.79
8	Very windy	— 4.89
10	Cloudy :	+ 0.79
11		+ 8.87 .
15	Fluttered much	+24.84 .
16		— 6.51
17		— 5.40
18	Clouds	— 5.76
20		— 5.93
21		— 5.24
22		— 5.10
29		— 3.79
30		— 4.54
31		— 7.80
June 1		— 2.01
6	Cloudy	— 1.10
10		+ 0.19
16		— 3.24
17		+ 0.14
18	Cloudy	— 2.95
21		— 4.75
22		— 3.35
23		— 3.94

		C. — O.
1756, June 26	Clouds	— 2″.59
27		— 2.64
29		— 0.66
30		— 3.71
July 3		+ 0.91
5		— 2.99
6		+ 4.57
11		— 4.03
12		+ 0.59
13		
15		— 3.08
19		+ 2.99
23		— 2.86
26		— 2.67
27		— 1.98
29		— 1.98
Aug. 3		— 0.60
7	Cloudy	— 2.39
10		— 0.39
13	Clouds	+ 3.70
14		— 1.49
18	Cloudy	+ 3.97
28		— 0.38
29		— 2.92
30		— 2.46
31		— 4.47
Sept. 1		— 1.55
2		— 4.54
3		— 3.08
4		— 4.14
8	Cloudy	— 0.62
11		— 3.16
12		— 0.65
13		— 0.12
14		— 0.63
15	Fluttered	— 6.15
16		— 1.14
17		— 1.62
21		— 2.60
23		— 1.55
24		+ 3.06
26		+ 5.60
27		+ 2.63
28		— 0.85
Oct. 1		+ 0.73
2		+ 2.27
5		+ 3.33
6	Clouds	+ 0.38
7	Clouds ::	+ 8.88 .
8		— 2.62
12		— 4.51
16		— 0.61
20		— 2.67
24		+ 0.02
29		— 8.63
30		— 4.20
Nov. 1		0.00
4		— 3.11
7		
8		— 1.99
9		— 8.41
10		— 9.11
11		— 2.86
12		— 6.56

		C. — O.
1756, Nov. 17		— 0″.98
18		— 3.71
19		— 5.03
20		— 8.27
21		— 8.51
24		— 5.46
25		— 3.32
27		— 5.87
28		— 6.96
Dec. 13		— 5.57
15		— 2.51
16		— 2.68
19	Hazy	— 2.04
23		— 2.79
1757, Jan. 2		— 4.07
3		— 7.00
7		— 8.98
17	Hazy	— 1.13
20		+ 3.55
22		— 4.58
23		— 1.71
24		— 4.85
27		— 7.22
Feb. 1		— 2.18
7		— 7.05
8		— 3.34
9	Fluttered	— 0.12
18		— 4.73
22		— 4.80
23		— 6.07
24	High wind	— 7.65
26		— 6.40
Mar. 2		— 5.23
8		— 4.07
11		— 2.54
16		— 4.66
19		— 0.75
20	Windy	— 2.27
22		— 4.30
24		— 4.43
26		— 2.42
31		— 2.52
April 6		— 3.25
8		— 3.82
9		— 4.85
13		— 3.47
15		— 2.55
18		— 0.07
19	Hazy	— 4.07
May 2		— 8.25
3		— 8.21
9		— 9.27
12		— 5.19
17		— 3.91
19		— 6.55
20		— 2.99
21		— 6.30
27		— 3.62
28		— 3.36
June 11		— 5.57
12		— 1.73
13		— 0.89
14	Clouds	— 0.56
15		— 0.22

		C. — O.			C. — O.			C. — O.
1757, June 17	A little hazy	— 4″.35	1757, July 6		— 2″.46	1757, July 23		— 3″.38
22		— 2.37	9		— 0.80	25		— 3.45
25		— 1.03	10		— 0.73	26		— 3.21
26		— 2.06	12		— 2.55	27		— 5.44
27	Hazy	+ 2.95	13		— 3.46	28		— 3.21
28	Clouds	+ 1.43	14		— 3.34	31		— 4.95
30		+ 2.43	17		— 3.45	Aug. 2		— 3.92
July 5		— 0.50	21		— 2.31	4	Cloudy	— 1.37

(*To be continued.*)

OBSERVATIONS OF THE TWENTY-FOURTH AND TWENTY-FIFTH ASTEROIDS,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury.]

THEMIS.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉔ — *		㉔'s apparent		A.
				$\Delta\alpha$	$\Delta\delta$	α	δ	
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
June 5	9 44 7.1	17	Weisse XI. 233	+1 18.68	+14 22.96	11 15 19.44	+5 15 10.08	8
8	9 9 37.8	10	" 258	+2 4.63	+ 3 27.84	11 17 34.04	+4 59 56.88	7
9	8 48 10.4	5	" 258	+2 50.63	— 1 41.76	11 18 20.02	+4 51 41.16	8
10	9 20 58.9	6	B. A. C. 3888	+0 51.88	+ 9 10.62	11 19 8.93	+4 49 16.19	9

At the last observation the planet was of the 14 magnitude.

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XI. 233	9	11 13 15.10	+5 1 46.89	Weisse's Catalogue and Santini.
" 258	8.9	11 14 2.54	+4 57 28.57	Weisse's Catalogue.
B. A. C. 3888	7	11 18 7.51	+4 41 6.14	B. A. C., Weisse, and Santini (mean).

PHOCEA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉕ — *		㉕'s apparent	
				$\Delta\alpha$	$\Delta\delta$	α	δ
1853.	h. m. s			m. s.	′ ″	h. m. s.	° ′ ″
June 29	8 40 56.2	2	Rümker 4697	+2 0.22	— 6 37.78	14 20 28.34	+1 32 57.08
	9 36 13.0	6	"	+2 1.70	— 6 29.39	14 20 29.82	+1 33 5.48
	9 39 6.4	5	B. A. C. 4798	—1 52.08	+ 3 54.60	14 20 30.10	+1 33 3.33
July 4	9 9 43.4	13	"	+0 49.38	+13 13.36	14 23 11.52	+1 42 22.28
	10 49 6.4	7	"	+0 51.77	+13 21.60	14 23 13.91	+1 42 30.53

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h m. s	° ′ ″	
Rümker 4697	7	14 18 17.85	+1 40 26.19	Rümker's Catalogue.
B. A. C. 4798	5.6	14 22 11.89	+1 29 59.37	B. A. C., Weisse, Rümker, and Santini.

Phocea is of the 10.6 magnitude.

SOUTHERN COMET.

LETTER FROM LIEUTENANT GILLISS TO THE EDITOR.

Washington, 1853, *May* 23.

I send you an extract from Dr. Mösta's letter to me received this morning.

Other correspondents inform me, that the comet was so bright it had attracted their attention in walking through the streets of Santiago, and they had gone to the Observatory to examine it with the telescope. It must have been visible to the eye as early as April 28.

Our observations establish the fact of an error in the tabulated place of β *Hydri.*

J. M. GILLISS.

LETTER FROM DR. C. W. MÖSTA TO LIEUTENANT GILLISS.

Santiago de Chile, 1853, *May* 10.

On the evening of the 30th of April, which was the first clear one for more than a fortnight, I saw a comet in the constellation *Lepus*. Its position could only be ascertained on that evening by the equatorial, and is not satisfactory. The following nights were more favorable, and the observations are as good as the faint light of the comet permitted them to be made. On the 1st of May I compared it with Weisse No. 211, Hora V.; on the 2d, with a very small star whose position was obtained by comparison with W. No. 846; on the 3d, with W. No. 1593, both of the same hour. The night of the 4th was cloudy, and on the 5th it had disappeared. I intended communicating the observations to you, but much other work has prevented the necessary reductions in time, and I must delay it until the next steamer. ..... Several reductions induce me to believe that there is an error in the published positions of β *Hydri* or β *Chamæleontis.* My observations were made chiefly for the purposes of determining the positions of some good azimuth stars.

C. W. MÖSTA.

NEW COMET.

A small comet was detected on the night of the 10th of June by Mr. Klinkerfues, the assistant at the Göttingen Observatory. His observations were as follows: —

	Göttingen M. T.	α	δ	Comparison-Star.
	h. m. s.	h. m. s.	° ′ ″	
1853, June 10	13 0 53.6	9 31 53.77	+43 28 17.1	Lalande 18953
11	11 25 3.0	9 32 29.97	+43 23 57.9	" 19022

The comet had a tail 3′ or 4′ in length.

G.

NOTICE.

The beautiful collection of astronomical and physical instruments provided for the Observatory of Count Casimir Batthyany at Biczske in Hungary, and which, owing to the political troubles of 1848, have never been used, is now offered for sale. The collection, which I saw at Biczske in 1847, comprises an ample supply of beautiful instruments from the most eminent mechanicians, and it was intended that, so far as possible, every instrument should be the best of its kind. Farther information may be obtained by applying to Mr. Robert Walsh in Paris, to Lieutenant Maury in Washington, or to myself.

G.

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SEMIDIAMETER OF THE SUN, INVESTIGATED FROM GREENWICH OBSERVATIONS.

BY JOSEPH WINLOCK.

COMPARISON OF BRADLEY'S OBSERVATIONS.

(*Continued from page* 103.)

		C. — O.			C. — O.			C. — O.
1757, Aug. 5		— 3″.62	1757, Oct. 26	Hazy	— 3″.08	1758, Feb. 7		— 4″.69
7		— 1.03	28	Clouds	— 3.17	8	Windy	— 6.45
8		— 4.71	29		— 5.67	11		— 4.28
9		— 3.87	30	Hazy	+ 0.68	14	Clouds	— 2.69
10	Hazy	— 1.06	Nov. 2		— 2.07	15		— 2.10
13		— 0.50	7		— 5.04	17	Clouds	— 4.72
15	Clouds	+ 2.21	8		— 8.50	21	Clouds	— 6.21
17		— 1.16	9		+ 1.55	24	Clouds	— 4.50
28	Very windy	— 4.89	10		— 5.12	27	Clouds	— 2.88
29		+ 0.56	11		— 6.68	Mar. 5	Hazy	— 2.51
Sept. 1		+ 4.40	12		— 2.44	8	Clouds	— 3.47
4		+ 1.26	13		— 6.11	9	Hazy	— 6.57
6		— 2.30	14	Clouds	— 5.79	12	Hazy	— 4.02
8	Clouds	— 1.84	16	Clouds	— 6.17	16		— 9.03
11		— 2.35	17		— 5.96	24		— 1.66
13		— 1.38	21		— 5.81	28		— 5.37
14		— 0.35	22	Clouds	— 8.01	29		— 3.90
15		— 1.84	24	Clouds	— 3.94	30		— 1.97
16		— 6.31	25		— 4.40	31		— 5.47
17		— 3.30	27	Clouds	— 5.46	April 1		— 6.01
18		— 1.28	Dec. 1		— 6.79	3	Cloudy	+ 5.40
19		— 0.23	3	Clouds	— 6.97	4	Clouds	— 4.71
20	Clouds	— 0.72	5		— 8.32	5		— 6.72
21	Clouds	— 2.16	6		— 6.98	9		— 5.84
23		— 7.13	7		— 5.45	10		— 5.35
24	Clouds	— 3.61	8		— 5.94	12		— 7.86
28		— 5.50	10	Clouds	— 8.04	14		— 7.41
29		— 4.47	11		— 7.85	16		— 3.94
Oct. 1		— 2.42	13	Hazy	— 5.68	17	Clouds	— 3.93
2	Clouds	— 5.86	15		— 8.95	22		— 4.37
3		— 6.34	17		— 8.27	23	Clouds	— 5.39
4		— 9.42	18	Clouds	— 7.21	24		— 5.86
8	:	—10.82	20		— 7.57	May 2		— 3.71
9		— 5.29	24		— 3.54	3		— 9.16
11		— 7.31	28		— 6.30	6		— 5.98
14	Clouds:	+ 1.14	1758, Jan. 8		— 7.49	7		— 7.39
17		— 2.74	11		— 5.27	8		— 5.83
18		— 6.00	13	Faint	— 8.41	9		— 5.73
19		— 7.25	16		— 4.07	10		— 9.14
21		— 4.34	19		— 2.20	11		— 6.53
23		— 6.26	22		— 7.15	12		— 7.93
24		— 2.92	23		— 6.57	13		— 4.82

		C. — O.
1758, May 14		— 8″.17
16		— 6.40
17		— 8.70
18		— 3.07
19		— 7.43
20	Fluttered	— 5.77
21		— 6.60
23	A little hazy	— 2.76
24		— 7.06
27		— 2.46
29		— 6.59
June 2	Cloudy	— 0.16
3		— 8.92
4		— 2.16
7		— 3.77
8		— 5.96
9		— 7.14
10		— 6.84
11		— 0.97
13		— 5.76
15		— 5.07
20		— 5.56
21		— 2.65
23		— 2.82
24	Hazy	— 5.86
26		— 6.48
27		+ 0.96
28	Cloudy	— 5.57
July 2	Clouds	— 8.09
3	Clouds	— 4.60
4		— 6.08
5		— 2.53
9	Cloudy ::	+ 4.43
12		— 2.98
13		— 4.87
14		— 7.24
15		— 4.55
16		— 3.97
17		— 2.82
20		— 5.33
23		— 2.79
27	Clouds	— 1.98
29		— 5.54
30		— 0.83
Aug. 2		— 5.55
5		— 6.68
6	Clouds	— 4.85
8	Cloudy :	— 7.73
10	Clouds	+ 1.00
11		— 4.72
12		— 0.87
13		— 6.95
16		+ 2.61
17	::	+ 3.98
19		— 6.65
21		— 5.95
22		— 3.63
23		— 5.64
24	Clouds	— 0.73
27	Clouds	— 2.47
29		— 1.58
30		— 5.18
31	Hazy	+ 1.81
Sept. 2		— 5.81
1758, Sept. 6		— 3″.41
7		— 1.42
9		— 5.42
10	Clouds ::	+ 1.57
13	Cloudy	— 7.39
16		— 6.82
21		— 3.77
22		— 2.26
24		— 9.28
25		— 2.27
26	:	—11.23
27		+ 1.75
28		— 5.20
Oct. 2	Cloudy :	— 0.12
10		— 5.58
11		— 5.36
13		—11.32
15		— 1.79
16		— 7.83
18		— 7.96
20		— 3.90
21		— 6.46
23		— 7.42
28	:	— 9.30
30		— 5.41
31		— 4.92
Nov. 2	Hazy	—13.36
3		— 7.75
6		— 0.62
7		— 8.73
8	Very windy	— 5.82
9		— 3.51
10	Hazy	— 0.16
11	Hazy	— 4.32
13		— 5.64
14	:	— 6.83
16		— 1.41
17	Hazy ::	—11.21
20		— 7.69
22		— 7.31
23		— 6.66
24		— 4.52
25		— 4.69
26		— 5.08
30		— 3.76
Dec. 7		— 4.52
8		— 8.88
11		— 5.53
13		— 5.46
14		— 4.99
19		— 6.04
22	Hazy	— 7.39
1759, Jan. 6		— 4.00
8	Clouds	— 4.74
19	:	— 4.77
20		— 4.98
21	Fluttered	— 5.49
22		— 4.65
23		— 5.59
29		— 4.82
Feb. 1		— 5.22
3		— 5.12
4		— 5.75
6		— 7.73
1759, Feb. 7	:	— 0″.37
11		— 7.67
12		— 7.37
19		+ 3.02
Mar. 7	Clouds	— 6.27
9		— 4.24
22		— 4.02
23		— 3.37
27		— 7.56
31		— 8.36
April 1		— 8.39
2		— 4.88
3		— 6.40
5		— 7.94
7		— 8.51
9		— 6.52
13		— 3.16
16		— 8.21
22		— 5.88
23	::	—14.79
24		— 5.79
25		— 6.79
28	Hazy :	— 8.71
29		— 9.17
30		— 7.63
May 1		— 9.40
2		— 7.53
3		— 6.95
6		— 6.24
7		— 4.68
16		— 3.27
17		— 5.51
19		— 7.89
20		— 4.24
21		— 6.57
23		— 2.74
25		— 5.28
27		— 7.48
31		— 6.03
June 8		— 7.78
9		— 6.99
10		— 8.17
11		— 7.84
13		— 7.65
14		— 3.32
16		
17		— 6.76
19		— 9.98
20		— 7.09
21		— 6.68
22		— 3.72
27		— 8.03
28		— 3.08
29		— 8.10
July 3		— 9.62
4		— 6.63
5		— 5.11
6		— 7.06
7		— 4.85
8		— 5.25
9		— 4.19
10		— 5.12
11		— 1.54
13		— 3.36

		C. — O.
1759, July 14		— 5″.26
15		— 3.61
16		— 4.55
18		— 4.79
19		— 8.52
21		— 7.86
22	Fluttered	— 7.12
23		— 6.96
24		— 1.27
25		— 7.51
26		— 6.32
28		— 3.85
Aug. 3		— 6.28
6	Cloudy :	— 6.36
9		— 7.37
10		— 2.10
11		— 7.79
16		— 5.10
18	:	—10.35
22		— 2.78
23		— 5.88
25	Last wire	— 6.51
26		— 4.08
28		—10.21
Sept. 1	Hazy	—12.38
4		+ 1.08
9		— 7.03
10		+ 0.97
13		— 6.10
14		— 8.65
15	:	— 2.10
19		+ 2.41
21		— 0.55
22		— 5.04
23	:	— 1.52
24		— 8.52
Oct. 1		— 1.25
5	Hazy	— 4.51
6		— 7.17
7		— 5.57
8		— 1.58
9		— 4.55
13	Windy	— 3.50
14	::	— 2.90
19		— 5.66
20		— 4.80
22		— 4.24
21		— 8.37
31		— 3.24
Nov. 3		— 6.07
4		— 5.59
6		— 7.75
8		
14		— 2.97
17		— 0.39
29		— 1.71
30		— 3.88
Dec. 5		— 7.01
7		— 8.73
8		— 7.12
10	Hazy ::	— 7.23
13		— 8.78
15		— 9.18
16		— 6.13
17		— 4.99
1759, Dec. 23		— 3″.96
26		— 2.43
27		— 6.59
28	::	— 6.45
31		— 8.27
1760, Jan. 2		— 3.74
8		— 5.48
9		—10.99
15		— 5.95
22	:	— 6.15
25		— 4.63
26		— 2.68
27		— 2.20
Feb. 2		— 4.18
6		— 1.97
8		— 7.61
9		— 6.30
10		— 5.29
14	Strong winds ::	— 7.73
15	A little hazy	— 3.05
16		— 1.16
18		— 2.32
26		— 3.54
Mar. 1		— 3.28
4		— 1.71
6		— 4.64
7		— 5.15
8		— 5.58
10		— 2.14
11		— 4.13
15		— 5.21
20		— 8.79
24		— 6.83
27		— 3.88
28		— 7.01
29		— 2.32
30		—10.05
31		— 3.57
April 2		— 3.68
3		— 2.71
4		— 2.26
5		— 4.77
7		— 4.79
10		— 5.41
11	Fluttered	— 1.51
12		— 3.00
13		— 3.06
14		— 3.68
16		— 3.18
17		— 4.65
20		— 3.68
21		— 8.28
22		— 1.14
23		— 0.16
26		— 7.58
27		— 0.60
28		— 6.54
29		— 5.98
May 3		— 3 84
11		— 5.81
12		— 6.73
13		— 4.14
14		— 5.61
15		— 5.41
22		— 6.47
1760, May 23		— 5″.69
24		— 6.46
31		— 8.96
June 1		— 5.10
3		— 2.20
4		— 4.96
7		— 5.69
9		— 1.10
10		— 6.79
11		— 9.99
13		— 5.30
14		— 5.46
18		— 0.45
24		— 5.89
27		—13.02
30		— 4.59
July 3		— 7.07
8		— 7.45
10		— 5.31
12		— 2.65
15		— 9.80
17		— 5.05
19		— 2.74
20		— 8.56
22		— 2.21
23	:	
26		— 3.36
29		— 0.15
30		— 3.43
Aug. 3		— 3.40
6	:	— 6.42
7		— 5.39
19	Hazy ::	— 4.08
20	:	— 7.87
22	:	— 8.75
23		— 7.40
25	::	— 1.38
26		— 8.23
28		— 4.29
Sept. 1		— 9.94
2		— 3.07
6		— 4.25
7		— 6.22
8		— 3.35
10		— 2.77
11		— 8.27
12		— 1.40
13		— 8.28
14		— 2.37
17	Hazy	—13.18
22		— 5.12
23		— 7.98
24		— 3.99
25	Windy	— 8.44
Oct. 4	::	— 3.34
10		— 8.24
11		— 7.79
20		— 5.15
Nov. 7	Clouds	— 3.82
Dec. 4		—10.68
6		—12.64
15		— 4.38
20		— 6.96
22		— 3.77
23		— 2.28

		C. — O.
1760, Dec. 29		+ 6″.66
1761, Jan. 2		— 2.72
11		— 5.96
13		—12.70
17		—10.11
18		—10.18
23	Very Hazy ::	— 6.11
25		— 9.41
27		—10.15
30		—12.86
Feb. 2		— 6.31
3		—11.51
4		— 3.00
5		— 9.45
13	Cloudy	—12.41
16		— 9.37
18	Cloudy	—12.13
20		— 7.74
Mar. 1		— 6.73
2	Very faint	—13.14
8		— 8.06
9		—14.49
11		— 4.45
14		— 8.90
21	::	
25		— 2.72
26		— 5.26
29		— 9.97
30		+ 5.47
31		— 8.05
April 3		— 6.67
4		— 4.20
5		— 3.75
6		—11.24
14		— 7.42
16		—12.41
17		— 7.92
18		— 8.42
19		— 5.91
21		+ 1.06
23		— 3.92
24		— 6.41
25		— 4.96
May 4		— 4.16
7		—11.48
9		—11.32
14		— 5.19
15		— 6.57
22		— 7.97
21		—10.66
30		— 9.48
June 6		— 9.12
8		— 7.51
14		—11.43
22		—13.33
23		— 3.41
24		—10.49
25		— 9.57
30		+ 9.27
July 5		— 5.62
9		— 8.28
10		— 6.18
11		— 8.11
13	Cloudy	—10.85
15		— 6.62
1761, July 20		— 8″.46
21		— 9.74
22		— 4.48
25		—10.45
26		—10.74
27		— 9.46
28		— 4.31
30		— 9.80
Aug. 4		—11.41
5		— 3.11
6		— 7.81
7	Cloudy	— 8.48
11		— 8.15
13		— 5.36
18		— 9.55
20		— 9.79
22		— 3.99
25		— 7.75
26		— 7.34
27		— 5.93
28		—12.50
31		—12.17
Sept. 1		— 6.66
8		— 8.28
10		—10.23
12		— 7.27
14		— 4.21
18		— 7.23
20		+ 2.82
25		— 7.60
26		— 3.05
28		+ 4.95
Oct. 5	Hazy	— 0.44
6		+ 1.13
7	Hazy	— 7.29
10		— 8.73
16		—11.60
17	Glass, naked eye	— 2.75
21		— 6.27
22	Hazy	+ 7.12
27		— 7.74
Nov. 1		— 4.63
6		— 9.61
9	Hazy	— 2.45
10	Naked eye	— 5.09
11		— 8.73
12		— 7.41
17		— 1.89
28		— 7.85
30		— 5.34
Dec. 3		— 6.94
4		+ 0.10
5	Unusual tremor	— 6.74
8		— 8.95
11		+ 0.68
21	Very hazy	— 7.01
26		—11.63
27	Hazy	— 5.50
28		+ 2.22
30		— 4.36
31		—14.26
1762, Jan. 5		—12.97
7		— 6.11
8		— 7.88
13		— 4.79
1762, Jan. 16		+10″.02
19		— 5.80
21	Hazy	—13.32
23	Hazy, tremor	+ 1.32
24		—10.95
Feb. 1		— 4.15
5		— 6.35
6		— 5.40
7		— 5.56
10		— 3.39
19		— 6.54
22		— 8.70
28		—11.24
Mar. 9		— 6.32
10		— 3.84
11	Cloudy	— 1.33
21		— 2.57
23		— 5.64
28		— 6.33
30	Cloudy	+ 0.63
April 1		— 8.03
2		— 2.97
3		— 5.59
4		— 2.98
6		— 4.00
7		— 1.58
8		— 4.09
15		— 6.78
17		— 4.00
18		— 7.36
20		— 3.39
21	Very hazy	— 3.69
23		— 0.88
25		—13.87
27	Very hazy	+ 3.19
May 7		— 5.15
8		— 5.66
9		— 8.03
10		— 8.46
13		— 8.39
16	Q :	— 4.35
23		— 1.50
25		— 6.94
26		—11.21
28		— 2.81
29		—20.06
30	Doubtful	— 4.32
June 1	Q :	— 8.42
5		— 3.71
8		—12.33
13		— 7.23
15	Very cloudy	—17.53
18		— 7.03
19		— 3.06
23	Very hazy	+17.60
29		— 4.58
30		—21.59
July 7		— 7.36
10		— 1.14
12		—20.97
13		—12.86
14		— 4.75
15		— 1.67
16		— 8.56

OBSERVATIONS OF CALLIOPE AND PROSERPINE,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury.]

[Corrected for refraction.]

CALLIOPE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉒ — *		㉒'s apparent		A.
				Δα	Δδ	α	δ	
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
1852, Dec. 17	7 40 44.4	2	B. Z. 396	—1 25.68	+ 3 28.01	4 42 27.31	+26 35 4.71	10
	9 8 5.7	10	" 396	—1 29.79	+ 3 37.81	42 23.20	35 14.52	10
18	8 47 44.9	5	" 396	—2 28.15	+ 6 42.48	41 24.86	26 38 19.23	10
1853, Jan. 5	6 23 34.2	20	" 397	—0 40.25	—12 24.63	27 21.51	27 21 55.38	9
6	6 23 25.4	12	" 397	—1 11.93	—10 7.02	26 50.02	27 13.05	10
7	7 6 56.8	10	" 397	—1 43.21	— 7 46.91	26 18.51	29 33.19	10
17	6 54 11.0	4	" 397	+1 48.81	+ 3 12.15	22 59.58	51 21.11	10
19	6 39 34.2	14	" 397	+1 32.22	+ 7 36.41	22 42.97	27 55 48.16	10
21	6 26 3.5	10	" 397	+1 23.22	+11 59.06	22 33.96	28 0 10.83	10
27	6 40 6.9	3	(1)	—1 38.97	—11 16.07	22 53.29	13 39.60	7
	8 54 30.7	8	"	—1 38.41	—11 1.85	22 53.85	13 54.82	7
28	6 37 10.3	7	"	—1 29.44	— 8 49.89	23 2.81	16 5.83	7
31	9 54 13.4	5	B. A. C. 1048	—1 42.33	—15 44.67	23 44.02	23 14.88	8
		5	(1)	—0 48.89	— 1 43.05	23 43.32	23 12.70	8
Feb. 9	9 59 26.6	6	B. A. C. 1048	+1 51.23	+ 5 59.26	27 17.45	44 58.77	10
11	9 44 50.2	7	"	+2 54.89	+10 55.15	28 21.07	49 54.80	10
	10 13 29.9	10	B. Z. 397, 398	—0 48.06	—15 16.85	28 22.31	49 56.62	10
13	8 21 4.9	11	" "	+0 20.93	—10 25.89	29 31.26	54 47.50	10
	9 0 5.7	9	" "	+0 22.03	—10 21.45	29 32.36	54 52.14	10
14	9 44 51.1	10	" "	+1 01.63	— 7 45.09	30 11.94	28 57 28.37	8
17	9 27 24.0	2	" "	+3 5.27	— 0 6.91	32 15.53	29 5 6.56	9
25	8 52 11.0	11	B. Z. 398	—0 16.15	— 4 38.74	38 49.04	25 45.51	10
26	9 19 15.6	10	" 398	+0 39.57	— 1 59.36	39 44.75	28 24.88	8
Mar. 5	10 3 26.9	6	" 398	—1 19.55	— 9 44.88	46 46.14	46 34.95	10
		6	" 398	—1 53.93	— 6 58.99	46 46.39	29 46 31.44	10
14	10 53 43.3	2	" 398	+1 57.93	— 0 55.11	57 9.07	30 9 10.71	7
15	10 19 43.6	10	" 398	—0 41.26	— 3 36.77	4 58 22.15	11 23.43	10
19	10 2 34.6	3	" 513	—1 22.42	+ 7 35.03	5 3 27.54	20 49.80	9
	10 13 29.6	14	" 513	+0 16.41	+ 5 41.65	3 27.91	42 6.15	11
29	9 14 57.9	12	" 513	+1 1.40	+ 8 30.39	17 10.70	42 6.15	8
April 2	10 5 20.9	20	" 513	+0 40.16	+ 1 5.87	23 4.84	49 41.18	9
5	10 37 43.9	5	" 513	+1 5.39	— 8 6.30	27 38.13	30 51 51.00	10
10	9 10 52.6	16	" 525	—0 39.22	—12 54.75	5 35 18.60	31 2 35.30	10
27	8 56 10.2	7	" 525	+1 10.93	+ 6 20.98	6 3 21.27	18 19.51	10
(¹)	8 56 38.0	6	" 525	—0 35.87	— 8 26.03	6 3 21.49	+31 18 17.54	10

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.	No. of Comp.
		h. m. s.	° ′ ″		
B. Z. 396	8.9	4 43 41.85	+26 31 16.89	Bessel's Zones.	
" 397	9	4 27 50.57	27 36 54.20	α from B. Z.; δ from Washington Mural.	
" 397	9	4 20 59.70	27 47 41.74	" " " "	
(1)	10	4 21 21.22	28 24 29.15	α from Wash'n Transit; δ from W. Equat.	5
B. A. C. 1408	7	4 25 15.34	28 38 33.11	α from B. A. C.; δ, Washington Mural.	
B. Z. 397, 398	9	4 28 59.15	29 4 47.62	α from Bessel; δ, Washington Mural.	
B. Z. 398	8	4 38 54.10	29 30 0.64	Bessel's Zones.	
" 398	9	4 47 58.08	+29 55 58.35	"	

(¹) Towards the end of the series the stars were so numerous that a fixed one was sometimes taken for the asteroid.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 398	8	4 48 29.71	+29 53 9.12	Bessel's Zones.
" 398	9	4 55 0.47	30 9 46.02	
" 398	9	4 58 52.73	30 14 43.29	
" 513	9	5 3 0.85	30 15 4.22	
" 513	9	5 4 39.30	30 12 57.20	
" 513	8.9	5 15 58.70	30 33 21.09	
" 513	9	5 22 14.09	30 48 25.44	
" 513	9	5 26 22.18	31 2 48.10	
" 525	7	5 35 47.22	31 15 20.06	
" 525	8	6 1 59.82	31 11 55.31	
" 525	9	6 3 46.80	+31 26 40.70	

PROSERPINE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	*Proserpine* — *		*Proserpine's* apparent	
				Δα	Δδ	α	δ
1853.	h. m. s			m. s	′ ″	h. m. s	° ′ ″
July 7	9 18 39.5	4	Weisse XIII. 813	—1 2.26	— 6 7.02	13 46 39.27	—11 36 11.35
	10 28 35.5	4	" 813	—1 0.08	— 6 22.95	13 46 41.40	11 36 27.29
8	9 49 22.5	11	" 813	—0 18.03	—11 20.67	13 47 23.58	11 41 24.98
	9 55 50.5	6	" 808	+0 2.64	+ 2 8.53	13 47 23.99	—11 41 25.42

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	* α	* δ
		h. m. s.	° ′ ″
Weisse XIII. 813	(8)	13 47 31.05	—11 29 4.78
" 808	8.9	13 47 10.88	—11 42 34.32

The planet estimated as of the 12 magnitude.

It is desirable that the discoverers of planets or comets should as soon as practicable publish, in some print of general circulation, the results of the first observations which may afford sufficient data for the computation of an approximate orbit. When, as has already been often the case, the discoverer publishes only the first observation or the first two observations, with an interval of only a day or two, the information is of but limited use to the observer who can only receive it a month thereafter, and obliges him to examine a very considerable region of the heavens in search of the new body. For an instance, we may refer to the recent discovery of *Phocea*. This planet was discovered on the 6th of April, and a circular by Dr. Petersen announcing the discovery, and giving the comparisons of April 6 and 8, was received in the United States on the 13th of May, and communicated immediately to the observers in this country in a circular published by the Editor of this journal. The place of April 8 was incongruous with that of April 6, and when corrected, according to probabilities, gave so great an inclination to the orbit as to render both observations questionable. As a still further mishap, Mr. Rümker's observation of the 12th of May was first published as of the 18th (*Extra-Beilage* No. 860 *Astr. Nachr.*), giving a place discrepant with the observations of April 6 and 8, and also with those of Dr. Luther of May 2 and 4. Therefore from five good observations, one having the Δα with a wrong sign, and the other being put with a wrong date, there was nothing reliable from which to obtain an approximate orbit. And the planet was not found in the United States, that we know of, till June 29. As it requires no small portion of the time of observers to obtain sufficient observations of these minor planets to afford data for the computation of their orbits, the importance of communicating the first observations must be sufficiently apparent.

FROM A LETTER OF PROFESSOR PETERSEN TO THE EDITOR.

Altona, 1853, *June* 24.

I am at present recovering, and able to take a little walk daily, but still so weak that these few hundred steps entirely exhaust me. But I will inclose you those observations of the comet recently discovered by Klinkerfues which I have received up to this time.

1853.	M. T. Hamburg.	☄ α	☄ δ	Comp.
	h. m. s.	° ′ ″	° ′ ″	
June 13	13 3 14.5	143 29 42.3	+43 10 31.4	5
23	11 19 37.7	145 39 2.0	+42 9 23.1	17

The comparison-star for June 13 is one observed by both

Bessel and **Lalande**. The two observations agree in right-ascension very closely, but differ in declination. Mr. **Rümker** has used **Bessel**'s value, so that the places of the two comparison-stars are assumed as follows: —

	∗ α h. m. s.	∗ δ ° ′ ″
June 13	9 34 7.27	+13 24 4.6
23	9 42 14.79	42 12 5.0
	9 43 40.82	+12 9 10.1

At Berlin.

1853.	M. T. Berlin. h. m. s.	☄ α ° ′ ″	☄ δ ° ′ ″
June 17	11 58 42	144 15 44.7	+42 46 56.0
18	10 58 34	144 28 5.7	42 41 7.2
19	11 26 31.6	144 41 37.0	+42 34 46.4

At Vienna.

1853.	M. T. Vienna. h. m. s.	☄ α h. m. s.	☄ δ ° ′ ″	Comp.
June 17	10 21 42.7	9 37 0.30	+42 47 31.8	6

A. C. PETERSEN.

LETTER FROM PROFESSOR SAWITSCH TO THE EDITOR.

St. Petersburg, 1853, *June* $\frac{5}{17}$.

Permit me to send you some of my observations with the request that you will insert them in your *Astronomical Journal*.

The following positions refer to the time of transit over the meridian of St. Petersburg, and are corrected for parallax and refraction.

OPPOSITION OF *NEPTUNE*.

1852.	Ψ α h m. s.	Ψ δ ° ′ ″	Δ α s.	Δ δ ″
Aug. 18	22 49 20.85	—8 29 32.0	—1.02	—4.3
19	49 14.72	30 12.4	1.31	8.3
20	49 9.07	30 50.4	1.06	9.4
21	49 3.02	31 28.8	1.17	10.7
27	48 26.64	35 12.2	1.26	8.0
31	48 2.10	37 42.1	1.29	6.0
Sept. 1	47 56.26	38 20.6	1.04	6.2
2	47 49.95	38 59.6	1.22	8.3
5	47 31.62	40 56.8	1.10	11.2
7	47 19.56	42 8.2	0.81	6.8
8	47 13.26	42 48.0	1.02	9.6
10	22 47 1.08	—8 44 3.4	—1.08	—10.5
		Mean,	—1.11	—9.2

QUADRATURE OF *NEPTUNE*.

1852.	h. m. s.	° ′ ″	s.	″
Nov. 12	22 42 44.00	—9 9 13.1	+0.22	+2.8
21	22 42 40.70	—9 9 20.5	+0.47	+3.4
		Mean,	+0.34	+3.1

The columns Δ α and Δ δ are the errors of the Ephemeris for 1852, given in the Berlin *Astronomische Jahrbuch* for 1854. The comparison-stars were α, γ, θ, and 83 (Flamst.) *Aquarii*.

OPPOSITIONS OF PLANETS.

SATURN.

1852.	♄ α h. m. s.	♄ δ ° ′ ″
Oct. 27	2 54 13.23	+13 56 4.0
28	53 53.37	51 43.8
Nov. 11	49 27.13	35 29.8
21	2 46 21.30	+13 22 27.0

URANUS.

1852.	♅ α h. m. s.	♅ δ ° ′ ″
Nov. 11	2 15 2.45	+13 2 34.2
21	2 13 33.32	+12 55 5.1

PALLAS.

1853.	② α h. m. s.	② δ ° ′ ″
April 14	14 33 14.36	+20 14 39.5
21	27 46.10	21 49 57.2
23	26 10.41	22 13 52.2
26	23 45.08	22 46 53.7
27	22 57.34	22 57 11.1
28	14 22 9.25	+23 6 56.1

CERES.

1853.	① α h. m. s.	① δ ° ′ ″
April 14	14 48 43.10	—3 35 21.9
20	43 45.90	21 41.4
21	42 51.00	19 44.4
23	41 8.94	16 0.4
27	37 35.25	9 22.8
28	14 36 40.93	—3 8 1.5

The comparison-stars were, for *Saturn* and *Uranus*, *ν Ceti* and Br. Assoc. Cat. 842; for *Pallas*, *α Bootis*; for *Ceres*, Br. Assoc. Cat. 4762.

I also take the liberty of communicating an extract from my memoir upon the changes of temperature at different heights in the atmosphere, — a subject not without astronomical interest, inasmuch as the theory of refraction stands with it in such intimate connection.

It is known that the temperature diminishes with the height of the stratum of air, and it is generally assumed that the average amount of this diminution is about 1° C. for each 175 meters. But this hypothesis does not correspond with the observations, and if we omit the consideration of the accidental variations, it is from theoretical considerations highly probable that in the mean condition of the atmosphere the diminution of temperature is not uniform; and that on reaching the higher strata of the atmosphere it would be necessary to ascend more than 175 meters to experience a diminution of 1° C. In the same way it is to be expected that the temperature will diminish more rapidly in proportion as it is higher at the surface of the earth. For changes of temperature occur chiefly in the lower strata, and the temperature at the outer limit of the atmosphere may be regarded as constant.

I have in an empirical way endeavored to express the changes of temperature for increasing altitudes by a formula which should satisfy both the conditions above mentioned, and also the carefully made observations upon numerous mountains. It is evident that only the mean of numerous observations made under different atmospherical conditions could be used, and that isolated observations would render but little service.

The data of which I have availed myself are contained in the following table: —

Name of Place.	Altitude above sea-level. Meters.	Mean Temperature. Centigrade.	Authorities and Remarks.
Switzerland.			
Geneva,	407	+ 9°.7	Kaemtz's Meteorologie.
Grand St. Bernard,	2490	— 1.1	
Russian Caucasus.			
Height of	320	+28.1	According to Col. Chodzko. These temperatures are not the yearly means, but refer to the summer months. The observations correspond as regards time.
"	2300	+17.3	
"	2800	+12.3	
"	3200	+10.7	
"	3500	+ 8.1	
English Hindostan.			
Madras,	0	+28.1	According to Col. Sykes. (*Discussion of Meteor. Observations taken in India; Phil. Trans.*, 1850, II. 324.)
Calcutta,	5	+28.7	
Mahabuleskar,	1370	+19.5	
Dodabetta,	2630	+11.7	
Central America.			
Height of	0	+27.5	Mean of 20 determinations made at different seasons at heights between 2500 and 4850 meters. Humboldt, *Voyage aux Regions équinoctielles du Nouveau Continent*, 4e Partie, I. 196.
"	3150	+10.0	

I assume the probable height of the atmosphere as 75,000 meters, and the constant temperature at the outer limit = —50° Centigrade.

The determinations above cited may be represented with tolerable approximation by the following formula:

$$t_1 - t = s\,(0.6 - 0.01\,t_1) + s\,.\,3.6\,(1 - 0.02\,t_1)\,e^{-0.05\,s}$$

or still more nearly by the formula

$$t_1 - t = s\,(4.2 + 0.088\,t_1 - 0.2\,s)$$

where t_1 and t are the temperatures of the lower and higher stratums, expressed in centesimal degrees; s, the height of the one station above the other; 1000 meters being taken as the unit of altitude; and $e = 2.71828$, the basis of the natural system of logarithms.

Comparing the latter formula with the observations, we obtain,

Place.	Observed Temperature.	Computed Temperature.	Error of Formula.
Geneva and St. Bernard	+10°.8	+ 9°.8	+1°.0

Place.	Observed Temperature.	Computed Temperature.	Error of Formula.
Caucasus,			
320 and 2300 meters	+10°.8	+12°.5	—1°.7
320 and 2800 "	+15.8	+15.4	+0.4
320 and 3200 "	+17.4	+17.7	—0.3
320 and 3500 "	+19.7	+19.3	+0.4
Madras — Calcutta and Mahabuleskar	+ 8.9	+ 8.8	+0.1
Do. and Dodabetta	+16.7	+16.3	+0.4
In America for 4500 meters	+17.5	+20.4	—2.9

As a test of our formula the celebrated experiment may be used which Gay-Lussac made in Paris at the beginning of our century. Ascending in a balloon to the elevation of 6909 meters above the level of the Seine, he noted the temperature, —9°.5, at the same time that the observer below noted the temperature, +30°.7. According to this experiment, the altitude of 6909 meters corresponds to a decrease of 40°.2 in the temperature; while our formula gives us 38°, — being therefore in error by only 2° C.

A. SAWITSCH.

CONTENTS.

Semidiameter of the Sun, investigated from Greenwich Observations, by Joseph Winlock.
Observations of Calliope and Proserpine, made with the Filar-Micrometer of the Washington Equatorial, by Mr. James Ferguson.
From a Letter of Professor Petersen to the Editor.
Letter from Professor Sawitsch to the Editor.

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OBSERVATIONS OF ASTEROIDS, AND OF THE THIRD COMET OF 1853,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Minor.]

[Corrected for refraction.]

IRIS.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑦ — *		⑦'s apparent		A.
				Δα	Δδ	α	δ	
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
April 18	10 55 30.2	12	Weisse XI. 618	—2 7.86	+ 8 27.35	11 33 11.59	—5 27 48.83	9
21	10 15 53.2	14	(5)	--0 51.79	+ 6 56.97	11 31 48.50	5 10 53.17	10
22	10 12 56.0	12	(5)	—1 17.23	+12 24.04	11 31 23.06	5 5 26.10	9
27	10 15 52.7	10	Weisse XI. 462	+2 41.67	+ 3 2.07	11 29 35.44	4 40 0.82	10
		10	" 466	+2 23.51	+ 6 46.27	11 29 35.48	4 40 3.74	10
28	10 8 43.3	6	" 462	+2 25.15	+ 7 38.46	11 29 18.91	4 35 24.41	9
		6	" 466	+2 6.89	+11 24.07	11 29 18.84	4 35 26.04	9
30	9 45 50.7	6	" 468	+1 33.07	—17 55.05	11 28 49.36	4 26 33.90	9
(1) May 1	8 51 49.2	3	" 468	+1 20.55	—13 50.04	11 28 36.83	4 22 28.87	5
3	10 16 51.2	12	" 468	+0 59.72	— 5 31.18	11 28 15.98	—4 14 9.97	10

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.	No. of Obs.
		h. m. s.	° ′ ″		
Weisse XI. 618	9	11 35 9.77	—5 35 9.60	Weisse's Catalogue.	
(5)	9	11 32 30.33	5 16 43.67	Washington Equatorial.	7
Weisse XI. 462	7	11 26 43.88	4 41 56.79	Weisse's Catalogue.	
" 466	9	11 27 2.08	4 45 43.88	" "	
" 468	8	11 27 6.41	—4 7 32.91	" "	

HEBE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑧ — *		⑧'s apparent		A.
				Δα	Δδ	α	δ	
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
April 27	9 30 47.9	10	B. A. C. 2788	+0 23.95	— 3 33.83	8 12 9.13	+21 8 58.11	10
28	7 52 27.3	10	"	+1 26.03	— 3 58.07	8 13 11.98	21 8 34.92	9
30	8 2 47.0	6	B. Z. 278	+1 4.35	+ 5 15.60	8 15 27.54	21 7 24.81	9
	8 59 43.3	5	"	+1 7.36	+ 5 16.70	8 15 30.56	21 7 25.91	9
May 2	9 47 13.4	7	Rümker 2533	—3 5.62	+11 0.18	8 17 50.80	+21 5 49.68	10

(1) Very high wind.

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 2788	5.6	8 11 35.74	+21 13 1.96	B. A. Catalogue and Rümker.
B. Z. 278	9	8 14 13.02	21 2 39.74	Bessel's Zones.
Rümker 2833	9	8 20 46.27	+20 55 21.41	Rümker and Bessel's Zones.

PALLAS.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	② — *		②'s apparent		A.
				Δα	Δδ	α	δ	
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
May 11	8 14 18.4	10	B. Z. 462	+0 37.41	—1 34.19	14 12 17.72	+24 39 10.94	10
13	8 6 20.0	10	" 462	—0 41.11	+6 26.97	14 10 59.21	24 47 12.57	10
June 2	8 30 4.5	6	" 462	+0 25.11	—8 35.06	14 1 57.23	24 52 16.28	10
18	10 4 59.5	6	" 364	—1 54.98	—4 47.93	14 0 59.88	+23 39 50.19	9

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 462	8.9	14 11 30.71	+24 41 38.03	Bessel's Zones.
" 462	7	14 1 22.54	25 1 41.35	
" 364	9	14 2 45.37	+23 52 7.28	

CERES.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	① — *		①'s apparent		A.
				Δα	Δδ	α	δ	
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
May 9	9 6 53.8	7	Weisse XIV. 519	—1 50.06	+ 7 47.25	14 26 43.07	—3 0 34.11	10
		7	" 510	—2 47.37	+14 30.20	14 26 43.05	3 0 34.43	10
15	9 54 51.2	10	" 422	—1 31.23	+ 5 16.08	14 21 45.15	3 3 26.43	10
31	8 30 53.7	12	" 221	—0 58.72	— 1 17.99	14 12 34.89	3 36 2.15	10
June 1	8 45 51.3	4	" 221	—1 27.02	— 4 33.18	14 11 6.59	—3 39 17.35	10

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XIV. 519	9	14 28 22.53	—3 7 27.10	Weisse's Catalogue.
" 540	8	14 29 19.82	3 14 10.53	"
" 422	9	14 23 5.77	3 7 47.86	"
" 221	9	14 12 23.02	—3 33 48.51	"

PSYCHE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑯ — *		⑯'s apparent		A.
				Δα	Δδ	α	δ	
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	
May 22	8 41 51.7	12	Weisse XIV. 252	—1 50.98	+11 19.39	14 12 37.84	—9 2 5.92	8
31	11 41 46.1	14	" 130	—0 25.96	+ 0 2.90	14 7 45.72	8 41 29.91	10
June 1	10 1 40.5	10	" 130	—0 51.06	+ 1 37.98	14 7 20.61	8 39 54.79	10
2	11 19 17.0	6	" 130	—1 18.14	+ 3 18.82	14 6 53.52	8 38 13.93	10
8	11 43 32.3	5	" 130	—3 30.39	+ 9 6.95	14 4 41.27	8 32 25.58	8
	11 49 2.8	4	" 88	—1 10.78	— 5 32.22	14 4 41.01	8 32 26.14	8
9	10 37 22.5	6	" 88	—1 38.78	— 4 10.56	14 4 13.01	—8 31 31.46	8

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XIV. 252	9	14 14 17.99	—9 12 28.53	Weisse's Catalogue.
" 130	8.9	14 8 0.91	8 40 35.46	"
" 88	9	14 5 41.08	—8 25 56.57	"

III. COMET, 1853. (Klinkerfues.)

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	☄ — * Δα	☄ — * Δδ	☄'s apparent α	☄'s apparent δ
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
July 28	8 52 58.3	8	B. Z. 407, 118	+1 19.72	—4 49.11	10 35 21.52	+37 12 30.65
30	8 51 41.9	8	" 499, 123	—1 29.08	+5 26.16	39 29.52	36 46 36.15
Aug. 6	8 44 44.3	6	" 499, 138	—0 57.84	—3 58.52	54 56.34	+34 56 59.15

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 407, 118	8.9	10 33 51.85	+37 18 9.21	Bessel's Zones.
" 499, 123	9	40 48.73	36 42 0.13	
" 499, 138 " 357, 19	9	55 45.83	+35 1 50.16	

July 28. Misty. The comet has a condensed bright nucleus of about eight seconds diameter. The size of the coma could not be estimated. The comet would probably be visible to the naked eye in a clear night.

Aug. 9. The comet increasing in brightness. The nucleus condensed. Coma very faint, scarce visible in the moonlight.

ERRATA IN WEISSE'S CATALOGUE.

While engaged in the preparation of a Catalogue of all the stars from the equator to 1° of north declination, undertaken for the Observatory of Harvard College, at the request of the Director, the following errata have been detected in Weisse's Catalogue.

I began by selecting and reducing the stars from the smaller catalogues. Having found discrepancies between some of these reductions and the places given by Weisse, I was led to conclude that it might be well for greater security to re-reduce Bessel's Zones as far as I should need them.

The annexed list is the result of my comparison with Weisse. I am not aware that any of these are already pointed out.

Several minor discrepancies are omitted.

All errors found in Bessel's Zones, as well as in the other catalogues, by comparison with the zone observations made at the Observatory, will be found in notes to the Catalogue.

Hora.	No.	*for*	*read*
0	99	δ +0° 25′ 39″.3	+0° 24′ 39″.3
0	206	δ +0 37 35.7	+0 36 35.7
0	258	α 13 42.55	13 42.75
0	406	α 23 8.16	22 58.16
0	611	α °33′ 58″.43	°33′ 59″.34
1	477	δ +0 51 36.0	—0 52 44.2
2	290	α 16 22.99	16 22.76
2	290	δ +0 47 20.6	+0 47 23.6
2	567	δ +1 8 51.3	+1 6 32.2
2	618	δ —1 1 6.3	+0 58 46.1
2	686	δ —0 21 33.5	+0 19 7.4
2	692	δ +1 0 25.8	+0 58 5.1
2	723	δ +0 13 48.6	+0 11 23.4
2	737	δ +0 16 34.2	+0 14 9.0
2	757	δ +1 0 50.9	+0 58 30.0
2	833	δ +0 40 46.5	+0 38 23.3
2	900	δ +0 34 47.0	+0 32 22.8
2	906	δ +0 59 13.7	+0 56 51.9
2	930	δ +0 18 48.2	+0 16 22.5
2	950	δ +0 29 51.5	+0 27 26.5
2	982	δ +0 42 56.8	+0 40 32.9
2	1007	δ +1 12 49.7	+1 10 28.6
2	1023	δ +0 12 29.2	+0 10 2.3
2	1035	δ +0 33 43.3	+0 31 18.3
2	1069	δ +0 45 58.3	+0 43 34.3

Hora.	No.	*for*	*read*
2	1071	δ +0° 13′ 37″.6	+0° 11′ 10″.4
2	1089	δ +0 28 48.2	+0 26 22.5
4	929	α 41 33.61	41 32.86
4	1302	α 56 35.60	56 34.60
5	1085	δ +0 6 28.8	+0 5 28.8
5	1513	δ +0 2 20.9	+0 1 20.9
6	974	δ +0 43 51.4	+0 43 53.2
7	1202	α 38 4.68	38 4.08
8	384	δ +0 2 54.7	+0 0 54.7
8	580	δ +0 35 31.4	+0 35 51.4
8	865	α 31 31.79	31 34.79
9	278	δ +0 33 55.7	+0 33 56.7
10	118	δ +0 34 51.2	+0 35 52.2
10	405	α 21 30.82	21 20.82
10	679	δ +0 50 2.1	+0 49 58.1
10	1034	δ +0 0 47.6	—0 0 47.6
11	583	α 31 57.69	31 57.99
12	420	α 24 0.04	24 2.04
12	420	δ +0 41 20.7	+0 41 21.7
12	829	α 46 59.66	46 59.46
14	514	δ +1 1 47.1	+1 0 47.1
14	999	α 51 55.87	50 55.87
14	984 is 999		
15	451	δ +0 43 20.2	+0 43 2.6
15	515	δ +0 51 10.3	+0 51 12.3
16	456	δ —0 20 28.8	+0 20 28.8
16	994	δ +0 37 28.4	+0 37 27.4
16	1167	α 59 56.39	59 50.39
17	841	α 41 1.13	41 1.33
19	20	α 0 48.95	0 49.15
19	20	δ +0 58 5.0	+0 58 3.0
19	33	δ +0 39 29.8	+0 39 28.8
19	1096	α 41 41.33	40 41.33
19	1088	δ +0 1 26.3	—0 28 35.0
19	1239	δ +0 1 51.7	+0 1 49.3
19	1400	δ +0 13 5.6	—0 16 49.6
21	31	δ +0 55 56.0	+0 55 58.7
22	292	α 13 5.95	13 5.61
23	443	α 20 57.93	20 37.93
23	552	δ +10 15 18.9	+0 15 18.9

For convenience of reference, I have also collected the following list of errata in WEISSE's Catalogue from the various Nos. of the *Astronomische Nachrichten.*

Hora.	No.	*for*	*read*
20	14	δ + 5° 2′ 22″.5	+ 5° 3′ 22″.5
20	31	No. obs. 2	3 Zones 24, 181, 311.
20	45	δ + 7 57 34.0	+ 7 56 34.0

Insert between Nos. 65 and 66:

20	Mag. 9	α $20^{h.}\ 2^{m.}\ 21^{s.}.27$	δ +14 53 12.9	1 obs.

Hora.	No.	*for*	*read*
20	74	δ + 0° 56′ 21″.3	+ 0° 56′ 31″.3
20	133	δ — 6 33 16.7	— 6 34 16.7
20	168	δ +13 57 12.5	+13 37 12.5
20	187	α 6 56.45	5 56.45
20	248	δ —10 25 30.2	—10 25 20.3
20	257	δ —13 20 31.6	—13 20 39.6
20	301	δ — 9 52 16.9	— 9 55 16.9
20	321	δ + 9 46 43.3	+ 9 40 43.3
20	345	α 12 44.69	13 44.69
20	352	δ +14 13 23.6	+14 33 23.6
20	363	δ — 5 38 6.1	— 5 37 6.1
20	374	α 13 51.34	14 19.34
20	385	No. obs. 1	2 (Vgl. N. 374)
20	437	δ +	—
20	471	δ — 9 4 26.2	— 9 42 26.2
20	473	α 17 45.99	17 50.00
20	485	α 18 20.31	17 20.32
20	485	δ + 3 37 25.4	+ 3 37 25.2
20	589	δ + 1 17 43.6	+ 1 17 23.6
20	602	δ —10 26 27.5	—10 26 37.6
20	675	δ +	—
20	717	α 26 55.53	25 55.53
20	846	α 31 34.20	31 34.80
20	976	α 36 41.28	37 41.28
20	1099	α 41 2.01	40 2.01
20	1109	δ — 2 24 5.4	— 3 24 9.0
20	1185	δ + 7 10 20.3	+ 7 10 43.0
20	1186	α 44 51.51	44 51.82
20	1239	α 47 9.12	47 19.12
20	1279	δ + 4 34 47.9	+ 4 24 37.9
20	1280	δ +10 18 2.5	+10 18 32.5
20	1287	δ + 4 41 44.1	+ 4 41 34.1
20	1298	α 49 7.00	49 8.00
20	1327	δ + 2 54 3.3	+ 2 54 13.3
20	1344	δ + 7 58 51.9	+ 7 57 51.9

Insert between Nos. 1415 and 1446:

20	Mag. 9	α 55 4.37	δ — 9 57 16.1	1 obs.

Hora.	No.	*for*	*read*
20	1474	δ — 0 12 45.4	— 0 12 55.4
20	1477	δ + 3 52 28.1	3 52 38.1
20	1497	α 57 22.46	57 41.46
21	7	α 0 14.98	0 24.98
21	14	α 0 27.79	0 29.79
21	14	δ +15 6 27.7	+15 6 37.7
21	27	δ —10 3 9.1	—10 3 29.1
21	63	δ +14 44 39.6	+14 44 49.6
4	1096	α 48 27.63	48 26.63
20	130	α 4 47.40	α 4 22.10
20	130	δ —14 51 23.6	—14 24 50.2

J. D. RUNKLE.

Nautical Almanac Office, Cambridge, 1853, *July* 14.

ELEMENTS OF PROSERPINE, COMPUTED BY MR. A. KRÜGER.

M	358° 15′ 12″.1	1853, June 10.0.
π	227 34 . 4.6	Mean Equinox, 1853, Jan. 0.0.
☊	45 55 34.3	
i	3 36 14.0	
φ	4 20 30.3	
Log. a	0.418836	
“ μ	2.921752	

The ephemeris sent by Mr. Krüger is omitted for want of space. It extends to

1853.	α	δ	Log. △
	h. m. s.	° ′	
Sept. 9.5	15 4 2.2	—18 42.4	0.4389

SECOND COMET OF 1853.

LETTER FROM DR. C. W. MÖSTA TO LIEUTENANT GILLISS.

Santiago de Chile, 1853, *June* 12.

I inclose you my observations of the last comet, which you will know whether to publish. Although observed only during a very short period, I have attempted the elements of its orbit on the supposition of a parabola, and obtain the following results: —

T	Apr. 1 5h. 50m. M. T. Greenwich.
☊	47° 18′ 2″.6
i	38 37 58.0
π	303 17 36.0
q	0.39779
	Retrograde.

Cloudy weather for some weeks prior to April 30th prevented its being seen earlier. The observations made on that day have not been recorded; nearness to the horizon and want of a proper comparison-star making them too unsatisfactory. On the 1st of May, the tail measured 58′ in length, which length it retained very nearly on the following night, though its light became sensibly fainter. On the 4th, the weather was cloudy, and afterwards the comet could not be distinguished. Computing the heliocentric longitudes corresponding to May 1st and May 3d, we find, respectively, 213° 21′ 32″.6 and 211° 42′ 48″.8, and the motion was consequently retrograde. If my computations are correct, the comet could only have made a short excursion to the northern hemisphere.

Apparent Places of Comet.

					Assumed Mean Places, 1853, January 1.	
1853.	M. T. Greenwich.	☄ α	☄ δ	Comparison-Star.	✱ α	✱ δ
	h. m. s.	° ′ ″	° ′ ″		h. m. s.	° ′ ″
May 1	12 41 33.16	5 8 19.80	—13 35 23.1	Weisse V. 244	5 10 55.05	—13 40 51.7
2	11 28 56.38	5 34 52.79	—13 53 5.7	“ 846	5 33 10.63	—13 56 33.4
3	12 45 46.70	6 1 10.06	—14 11 44.8	“ 1593	6 1 11.10	—14 14 40.6

Assumed longitude 4h. 42m. 20s. west of Greenwich.

C. W. MÖSTA.

In the *Monthly Notices* of the Astronomical Society for 1853, June 10, is an extract from a letter of Lieut. Goodenough, R. N., to the Astronomer Royal, dated on board H. M. S. Centaur at Buenos Ayres: —

“As it appears to me that the following observations of a comet seen here may not be uninteresting, I beg to inclose them.

“The comet was first seen at 6h. 45m. P. M., April 30, a little southwest of *Orion*, bearing W. S. W. Its nucleus was very distinct from the coma, and shone as a star between the third and fourth magnitude. The coma extended (by estimation) about 2′ round the nucleus, and the tail, pointing nearly direct to the zenith, had a length of about 4°, its width increasing but little.

“An observation was taken as follows, at a little after seven P. M.: —

M. T. Greenwich.	True Dist. from *Sirius*.	True Dist. from *Castor*.
h. m. s.	° ′ ″	° ′ ″
11 9 37	34 43 50	58 22 33

“Both observations are corrected for refraction; they give a R.A. 4h. 22m. 20s. and Dec. 6° 45′ 2″ South.

"The evening of May 1 was cloudy, and only one observation could be obtained at

M. T. Greenwich. h. m. s.	True Dist. from *Rigel.*
11 32 2	5° 12′ 30″

the comet being in a direct line with λ *Leporis* and *Rigel.*"

The identity of the comet mentioned in this letter with that first seen by Schweizer, April 4, and mentioned by Dr. Mösta in his letter to Lieutenant Gilliss, will be made evident by a reduction of the comparison with *Rigel*, May 1.

This observation of Lieut. Goodenough gives the place of the comet

M. T. Greenwich. h. m. s.	α	δ
11 32 2	79° 7′ 34″	—13° 5′ 15″.6

or only a little more than two degrees from the place given by the Santiago observation of the same evening, viz.: —

h. m. s.		
12 41 33.2	77° 4′ 57″	—13° 35′ 23″.1

Lieut. Goodenough's observations of the preceding evening are manifestly erroneous. I have not succeeded in making either of the observed distances accord with the position indicated by the observations of Dr. Mösta on succeeding evenings, or in finding any explanation of the discordance by the supposition of mistake in the name of the star used. The corresponding place of the comet would be nearly as given by Lieut. Goodenough.

M. T. Greenwich. h. m. s.	α	δ
11 9 37	65° 34′ 52″.0	—6° 43′ 1″

But assuming an error of 10° in the distance from *Sirius*, and calling this distance 24° 43′ 50″, we find as the corresponding position of the comet

h. m. s.		
11 9 37	74° 7′ 59″.6	—14° 4′ 45″

which does not differ much more from the position to be inferred from the Santiago observations, than do the next day's observations of Lieut. Goodenough and Dr. Mösta from one another.

G.

FROM A LETTER OF PROFESSOR PETERSEN TO THE EDITOR.

Altona, 1853, *August* 4.

Mr. Bruhns in Berlin has computed the following elements and ephemeris of the Comet 1853, III.

Mean Berlin Time. Mean Equinox, 1853.0.

T	1853, Sept. 1.7028.
π	310° 57′ 35″.7
☊	140 32 12.6
i	61 30 59.2
Log. q	9.487034
	Direct.

These elements are computed from the observations at Berlin and Vienna, June 17, Berlin, July 3 and July 23, and represent the middle observation as follows: —

Calc. — Obs.

$\Delta\lambda\ \ -7''.9 \qquad \Delta\beta\ \ +2''.6$

Ephemeris for Mean Berlin Noon.

1853.	☄ α h. m. s.	☄ δ ° ′	Log △	Brightness.
Aug. 15	11 15 0	+31 36		
16	17 26	31 3	0.0860	35
17	19 50	30 28		
18	22 9	29 50		
19	24 24	29 8		
20	26 31	28 22	0.0420	59
21	28 38	27 32		
22	11 30 33	+26 36		
Aug. 23	11 32 15	+25 33		
24	33 38	24 24	9.9899	108
25	34 43	23 8		
26	35 28	21 44		
27	35 46	20 10		
28	35 33	18 25	9.9312	201
29	34 42	16 27		
30	33 6	14 16		
31	30 45	11 54		
Sept. 1	27 41	9 24	9.8772	313
2	23 56	6 48		
3	19 30	4 5		
4	14 32	+ 1 17		
5	11 9 6	— 1 37	9.8529	309
9	10 47 36	11 28	9.8666	217
13	10 29 25	—18 29	9.9008	128

The unit of brightness is that at the time of discovery.

Mr. Bruhns remarks, that, as the comet during the latter half of August will set more than half an hour after the sun, and possesses a great degree of brightness it will be distinctly visible to the naked eye. The brilliancy will be seen to be greatest during the last days of August, and the comet may possibly be seen in the early part of September.

A. C. PETERSEN.

FROM A LETTER OF PROFESSOR HUBBARD TO THE EDITOR.

Washington Observatory, 1853, *August* 25.

FROM observations at this place, August 6, 13, and 19, I have computed the following parabolic elements of the comet 1853, III., which will probably be sufficiently accurate for the reduction of observations.

T	1853, Sept. 1.69184	M. T. Greenwich.
☊	140° 31′ 28″.8	Mean Equinox, 1853.0.
ω	170 23 5.4	
i	61 31 52.1	
Log. q	9.487278	
	Motion direct.	

For the middle observation, these elements give ;

C. — O.

$$d\lambda = -8''.0$$
$$d\beta = -11.8$$

As the comet will shortly cease to be visible in northern latitudes, it is unnecessary to add an ephemeris. Astronomers south of the equator, however, may be able to obtain observations before sunrise during the latter part of September, and in October.

J. S. HUBBARD.

LETTER FROM REV. THOMAS HILL TO THE EDITOR.

Waltham, June, 1853.

I INCLOSE tables of the path of the central and annular eclipse of Friday, May 26, 1854 ; also, times of first and last contact for 112 different places ; from which, by interpolation, approximate times may be found for any place in North America, Japan, or the Pacific Ocean. These times may, I think, be relied upon within two minutes ; they were obtained by the machine described on page 67 of your first volume. The whole time spent in preparation of the tables, including every preliminary and every finishing operation, was ten hours. This time would of course be shortened by becoming practised in the use of the instrument. The results might be obtained to the nearest minute by a little more care in the adjustments.

The line of central eclipse may be drawn through the following points ; at which the times of central eclipse are given in Greenwich M. T.

Latitude.	Longitude.	Greenwich M. T.
°	h. m. s.	h. m. s.
20	12 35	6 55 30
25	11 32 30	7 11
30	10 39 30	7 43
35	10 12	8 2 30
40	9 45 30	8 25
45	9 12	8 48 30
50	7 37	9 35
50	6 42	9 55
45	5 12	10 21
40	4 7	10 29

FIRST CONTACT.

Lat. 10°		20°		30°		35°	
Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.
° ′ ″	h. m. s.	° ′ ″	h. m. s.	° ′ ″	h. m. s.	° ′ ″	h. m. s.
				13 40 30	6 36 0	13 47 30	6 43 0
11 55 30	5 51 0	12 7 30	6 3 0	12 28 30	6 24 0	12 38 0	6 33 30
10 54 30	5 50 0	11 5 30	6 1 0	11 22 30	6 18 0	11 34 30	6 30 0
10 5 30	6 1 0	10 13 40	6 9 10	10 26 30	6 22 0	10 36 30	6 32 0
9 26 30	6 22 0	9 30 0	6 25 30	9 38 30	6 34 0	9 46 30	6 42 0
9 0 0	6 55 30	8 55 30	6 51 0	8 59 0	6 54 30	9 3 0	6 58 30
8 39 50	7 35 20	8 27 30	7 23 0	8 23 40	7 19 10	8 25 0	7 20 30
		7 40 10	8 35 30	7 21 10	8 16 30	7 18 40	8 14 0
		7 12 10	9 7 30	6 55 40	8 51 0	6 44 20	8 39 40
		6 35 40	9 31 0	6 10 10	9 5 30	6 2 40	8 58 0
		5 48 40	9 44 0	5 26 10	9 21 30	5 12 50	9 8 10
		4 53 40	9 49 0	4 33 40	9 29 0	4 29 10	9 22 30
		3 51 40	9 47 0	3 36 40	9 32 0	3 31 40	9 27 0
				2 33 10	9 28 30	2 28 40	9 24 0

Lat. 40°		45°		50°		55°	
Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.
° ′ ″	h. m. s.	° ′ ″	h. m. s.	° ′ ″	h. m. s.	° ′ ″	h. m. s.
14 1 30	6 57 0	14 22 30	7 18 0	14 38 0	7 33 30	14 53 50	7 49 20
12 53 30	6 49 0	13 7 10	7 2 40	13 20 30	7 16 0	13 35 30	7 31 0
11 45 30	6 41 0	11 58 30	6 54 0	12 11 0	7 6 30	12 25 0	7 20 30
10 47 30	6 43 0	10 52 50	6 48 20	11 9 0	7 4 30	11 22 0	7 17 30
9 53 30	6 49 0	10 3 30	6 59 0	10 14 30	7 10 0	10 25 30	7 21 0
9 8 10	7 3 40	9 16 0	7 11 30	9 25 0	7 20 30	9 33 50	7 29 20
8 27 30	7 23 0	8 32 30	7 28 0	8 38 30	7 34 0	8 45 30	7 41 0
7 16 0	8 11 20	7 14 40	8 10 0	7 14 40	8 10 0	7 13 30	8 11 30
6 38 40	8 34 0	6 35 40	8 31 0	6 32 40	8 28 0	6 30 20	8 28 20
5 57 40	8 53 0	5 52 50	8 48 10	5 51 10	8 46 30	5 44 40	8 42 40
5 11 40	9 7 0	5 7 0	9 2 20	5 3 10	8 58 30	4 56 30	8 54 30
4 21 10	9 16 30	4 16 40	9 12 0	4 12 20	9 7 40	4 5 20	9 3 20
3 25 40	9 21 0	3 22 10	9 17 30	3 17 40	9 13 0	3 11 0	9 9 0
2 25 10	9 20 30	2 22 40	9 18 0	2 19 40	9 15 0	2 12 30	9 10 30

LAST CONTACT.

Lat. 10°		20°		30°		35°	
Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.
° ′ ″	h. m. s.	° ′ ″	h. m. s.	° ′ ″	h. m. s.	° ′ ″	h. m. s.
				15 17 40	8 15 30	15 20 40	8 18 30
14 4 50	8 2 40	14 10 40	8 8 30	14 18 10	8 16 0	14 22 50	8 20 40
13 7 10	8 5 0	13 14 10	8 12 0	13 24 10	8 22 0	13 30 10	8 28 0
12 10 10	8 8 0	12 21 10	8 22 0	12 34 40	8 32 30	12 41 40	8 39 30
11 19 10	8 17 0	11 36 30	8 34 20	11 50 10	8 48 0	11 56 10	8 54 0
10 28 10	8 26 0	10 52 40	8 50 30	11 7 30	9 5 20	11 13 10	9 11 0
9 40 30	8 38 20	10 8 50	9 6 40	10 26 10	9 24 0	10 33 40	9 31 30
		8 45 0	9 43 0	9 10 0	10 8 0	9 18 30	10 16 30
		8 5 10	10 3 0	8 31 40	10 29 30	8 39 30	10 37 20
		7 30 30	10 28 20	7 53 10	10 51 0	8 0 10	10 58 0
		6 55 40	10 53 30	7 14 10	11 12 0	7 18 10	11 18 0
		6 10 40	11 9 30	6 30 30	11 28 0	6 31 40	11 29 30
				5 40 10	11 38 0	5 39 40	11 37 30
				4 42 0	11 40 0	4 41 0	11 39 0

Lat. 40°		45°		50°		55°	
Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.	Longitude.	Greenwich M. T.
° ′ ″	h. m. s.	° ′ ″	h. m. s.	° ′ ″	h. m. s.	° ′ ″	h. m. s.
15 22 10	8 20 0	15 23 40	8 21 30	15 24 10	8 22 0	15 29 0	8 24 30
14 26 10	8 24 0	14 28 30	8 26 20	14 31 10	8 29 0	14 39 0	8 34 30
13 34 10	8 32 0	13 38 10	8 36 0	13 42 10	8 40 0	13 50 30	8 46 0
12 45 10	8 43 0	12 49 50	8 47 40	12 55 10	8 53 0	13 3 0	8 58 30
12 0 40	8 58 30	12 5 10	9 3 0	12 10 10	9 8 0	12 18 0	9 13 30
11 17 40	9 15 30	11 23 30	9 21 20	11 27 10	9 25 0	11 34 10	9 29 40
10 37 40	9 35 30	10 43 10	9 41 0	10 46 10	9 44 0	10 51 10	9 46 40
9 48 40	10 46 30	9 24 10	10 22 0	9 25 10	10 23 0	9 25 0	10 23 0
8 41 40	10 42 30	8 44 40	10 42 30	8 44 10	10 42 0	8 37 30	10 35 30
8 2 10	11 0 0	8 2 50	11 0 40	8 2 50	11 0 40	7 56 0	10 54 0
7 18 10	11 16 0	7 17 10	11 15 0	7 13 10	11 11 0	7 7 0	11 5 0
6 30 10	11 28 0	6 27 10	11 25 0	6 21 40	11 19 30	6 14 30	11 12 30
5 36 30	11 34 20	5 32 10	11 30 0	5 26 10	11 24 0	5 16 40	11 14 30
4 36 0	11 34 0	4 32 0	11 29 30	4 23 0	11 20 30	4 13 20	11 11 20

THOMAS HILL.

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ON SOME ERRORS PECULIAR TO THE OBSERVER, WHICH MAY AFFECT DETERMINATIONS OF THE DECLINATIONS OF STARS.

By PROFESSOR J. H. C. COFFIN,
OF THE WASHINGTON OBSERVATORY.

[Communicated by permission of Lieutenant MAURY, Superintendent.]

In a discussion which I have undertaken of the observations made with the Mural-Circle at the Washington Observatory previous to 1850, I have been led, as a preliminary inquiry, to examine whether any individual peculiarities of the observers enter into or affect the results.

In the method of observing employed, three distinct operations enter into each determination of a star's declination; first, the reading of the circle; secondly, the bisection of the star with the horizontal thread; and thirdly, the coincidence of the thread with its image, reflected from a surface of mercury, in determining the nadir-point. Each of these may be affected by some constant peculiarity of the observer.

Any constant error in reading the circle is, however, eliminated in the determinations of zenith distance or declination, when the readings of the circle both for the star and the nadir-point have been made by the same observer.

A constant error in judging of the bisection of a star is manifested in my own observations of zenith stars. These were sometimes observed as southern stars, i. e. with the body of the observer fronting south; sometimes as northern stars. The differences of the resulting declinations for several stars for these two positions of the observer are presented in the following table.

The eye-piece was movable in declination, and rarely occupied the same position on two consecutive nights. Otherwise these differences might be attributed to maladjustment of focus, and consequent parallax between the star and the thread, when they were viewed obliquely. Several readjustments of the threads to the focal position, made during the period, would render this effect of parallax variable, even with a constant position of the eye or eye-piece.

		$\delta_s - \delta_n$	No. of Obs.		$\frac{s\,.\,n}{s+n}$	
			s	n		
η Lyræ	1846	$+1''.53$	2	2	1.0	3.6, $\delta_s - \delta_n = +0''.63$
	1847	0.00	2	3	1.2	
	1848	0.52	5	2	1.4	
α Lyræ	1846	0.56	18	3	2.6	6.7, $\delta_s - \delta_n = +0''.56$
	1847	0.87	8	2	1.6	
	1848	0.39	7	4	2.5	
61^1 *Cygni*	1846	-0.16	9	3	2.3	3.0, $\delta_s - \delta_n = +0''.15$
	1848	$+1.23$	5	1	0.8	
61^2 *Cygni*	1846	-0.08	7	3	2.1	
	1848	$+0.58$	5	1	0.8	

$[hh] = 13.3$; Mean value of $\delta_s - \delta_n = +0''.487 \pm 0''.100$; Probable error of a comparison of two observations south with two north, for which $hh = 1$, $= \pm 0''.370$.

Regarding the zenith distances as positive in the direction to which the observer is turned, the correction of a zenith distance of a zenith star as observed by me is

$$\Delta_c z = +0''.243 \pm 0''.050.$$

Two observers were employed at the Mural-Circle, using the instrument on alternate working nights, with the same adjustments, and with all the instrumental circumstances the same, so far as under their control. The following table exhibits the differences of their resulting declinations, for groups of stars of nearly the same declination. The comparison is made of Lieutenant PAGE's observations in 1845, 1846, and

1847, and of Lieutenant Steedman's in 1847, 1848, and 1849, with mine during the same periods. They have all been reduced in the same way, with the same constants and to the same epoch (1850.0). For the observations of any star and for the nadir-point, the two observers during the period made use of the same divisions of the circle; and the circle-positions of the star have been combined with the circle-positions of the nadir determined by the same observer.

The observations made by day are excluded, as, from the very different illumination of the threads, an observer may judge differently of the bisection of a star from what he would at night, with the illumination from the lamp.

The coefficients for weight for each star are from the expression

$$hh = \frac{m\,n}{m+n}\left(\frac{0''.5}{\eta}\right)^2;$$

where η = the probable error of a single observed culmination of a star, varying with the zenith distance as in the following table, quoted from the *Washington Astronomical Observations*, Vol. II., Int. p. xxvi.

Zenith Distances.	η	$\frac{0.25}{\eta^2}$
0°	±0″.46	1.18
10	.47	1.14
20	.48	1.08
30	.50	1.00
40	.52	0.92
50	.55	0.82
60	.60	0.69
70	.70	0.52
80	±0.87	0.30

Previous to September 15, 1845, the Circle was mounted with its face west: since that time it has faced east. The vertical motion of the eye-piece was provided in April, 1846.

For stars below the pole, the supplement of δ is used.

1. FACE WEST, 1845. *C — P.*

Mean of Zenith Distances.	No. of Stars.	[*hh*]	$\delta_C - \delta_P$	ε
—64°.3	1	0.5	—1″.28	—1″.09
52.6	1	8.2	+0.31	+0.50
48.4	3	4.1	— .55	— .36
36.2	4	5.1	— .81	— .62
12.6	4	10.8	— .20	— .01
— 5.8	1	2.3	+ .28	+ .47
+ 5.8	2	3.7	— .32	— .11
12.5	2	4.2	— .48	— .27
18.3	2	3.5	— .03	+ .18
26.4	5	9.4	— .33	— .12
32.3	3	5.8	— .01	+ .20
45.0	3	5.0	+ .10	+ .30
54.2	3	5.4	— .35	— .14
+65.6	3	3.0	—0.36	—0.15

2. FACE EAST, 1845, 1846, 1847. *C — P.*

Mean of Zenith Distances.	No. of Stars.	[*hh*]	$\delta_C - \delta_P$	ε
—85.1	1	0.2	—0″.46	—0″.57
64.0	2	1.5	+ .38	+ .26
52.7	3	15.0	+ .28	+ .17
49.0	5	23.3	+ .36	+ .24
35.5	4	18.7	— .24	— .36
23.2	2	9.8	+ .18	+ .07
15.8	5	17.5	— .06	— .18
— 8.2	5	23.9	+ .16	+ .05
+ 7.3	3	9.3	+ .04	+ .28
10.6	4	11.2	— .49	— .25
15.6	5	17.8	— .25	.00
18.0	2	4.8	— .33	— .08
24.2	5	22.1	— .27	— .02
28.0	5	22.8	— .26	— .01
31.8	5	18.8	.00	+ .25
35.9	4	14.7	— .95	— .70
40.0	3	7.1	— .49	— .24
46.7	5	7.5	— .14	+ .11
52.2	5	8.6	+ .14	+ .69
55.5	2	3.2	— .04	+ .21
63.7	4	6.1	— .15	+ .10
+70.0	2	8.0	+0.12	+0.37

3. FACE EAST, 1847, 1848, 1849. *C — S.*

Mean of Zenith Distances	No. of Stars.	[*hh*]	$\delta_C - \delta_S$	ε
—64°.3	1	0.3	+1″.16	+0″.68
53.0	2	6.7	+0.50	+ .02
48.6	2	6.8	+ .55	+ .07
35.8	4	6.1	+ .11	— .37
23.0	1	2.2	— .16	— .64
15.0	3	9.3	+ .91	+ .43
— 9.2	5	9.6	+ .33	— .15
+ 7.2	3	9.2	+ .52	+ .33
11.1	5	11.4	+ .69	+ .50
15.5	5	9.2	+ .30	+ .11
18.1	3	8.6	— .14	— .33
21.3	6	14.3	— .02	— .21
27.9	5	14.3	+ .15	— .04
31.9	6	11.8	+ .15	— .04
35.7	4	6.1	+ .51	+ .32
40.5	3	6.4	+ .09	— .10
46.8	4	7.6	+ .19	.00
51.1	4	2.9	— .21	— .40
57.2	5	4.7	— .25	— .44
65.3	2	2.0	+ .08	— .11
+69.3	1	1.5	+0.06	—0.13

Representing by Δn the correction to be applied to the circle-reading for the error in observing the nadir-point; and by Δz, the correction of the observed zenith distance for the error in making the bisection of the star (the zenith distances being considered positive in the direction to which the observer was turned); the combination of the groups of northern and of southern stars in the preceding tables give the following equations: —

$$\begin{array}{lrlrrr}
(1). & [hh] = 31; & (\Delta_C n - \Delta_P n) - (\Delta_C z - \Delta_P z) & = -0''.193 & \pm 0''.129 & f = \pm 0''.72 \\
 & 40; & (\Delta_C n - \Delta_P n) + (\Delta_C z - \Delta_P z) & = -0.210 & \pm 0.049 & 0.31 \\
(2). & [hh] = 109; & -(\Delta_C n - \Delta_P n) - (\Delta_C z - \Delta_P z) & = +0.115 & \pm 0.057 & 0.59 \\
 & 165; & -(\Delta_C n - \Delta_P n) + (\Delta_C z - \Delta_P z) & = -0.237 & \pm 0.056 & 0.72 \\
(3). & [hh] = 41; & -(\Delta_C n - \Delta_S n) - (\Delta_C z - \Delta_S z) & = +0.176 & \pm 0.079 & 0.54 \\
 & 110; & -(\Delta_C n - \Delta_S n) + (\Delta_C z - \Delta_S z) & = +0.191 & \pm 0.049 & 0.52
\end{array}$$

$$\begin{array}{rlcl}
\text{From } (1), & \Delta_C n - \Delta_P n = -0''.201 & \qquad & \Delta_C z - \Delta_P z = -0''.008 \\
(2), & \Delta_C n - \Delta_P n = +0.061 & & \Delta_C z - \Delta_P z = -0.176 \\
(3), & \Delta_C n - \Delta_S n = -0.335 & & \Delta_C z - \Delta_S z = -0.141
\end{array}$$

In (1), more than in the others, Δn and Δz may both include a constant effect of parallax. The larger probable errors, f, of a comparison whose weight is $hh = 1$, for northern stars in (1) and southern stars in (2), are remarkable. These, together with the persistence of signs in the residuals, 2, for extended portions of the meridian, which is manifested in the result for separate stars as well as in the groups of the preceding tables, indicate that other terms are essential to a full discussion. Δz, instead of being a constant term, may vary with the zenith distance; and will involve a term of the form a tang. δ, if it be the habit of the observer to make the observation of the star at a particular distance from the meridian (for example at the vertical thread which precedes the middle one), instead of on the meridian; or of the form, a sin. $2\,\delta$, if he observe at a fixed time before or after culmination. The small deviation of the star from the horizontal thread in passing to the meridian might be inappreciable to the observer at the time; and, except for stars of great declination, is regarded in some observatories as unworthy of notice.

The observations of zenith stars are not included in the preceding comparisons. In observing such stars I generally stood with my right side to the pier: after 1846, the exceptions were noted and have already been referred to. Lieutenant Page usually stood with his left side to the pier, thus observing them as southern stars with the face of the instrument west; as northern stars with the face east. Lieutenant Steedman stood with his back to the pier, thus fronting towards the east. The constancy of these positions is doubtful. Assuming it, however, the comparison of the declinations by the several observers affords the following equations. The numbers (1), (2), (3), refer to the same periods as in the comparison of other stars.

$$\begin{array}{llrlrl}
(1.) & [hh] = 15; & & (\Delta_C n - \Delta_P n) - (\Delta_C z + \Delta_P z) & = -0''.53 & (3 \text{ stars.}) \\
(2.) & & 7; & -(\Delta_C n - \Delta_P n) - (\Delta_C z - \Delta_P z) & = +0.01 & (3\ \text{“}\ ) \\
 & & 18; & -(\Delta_C n - \Delta_P n) + (\Delta_C z + \Delta_P z) & = +0.38 & (4\ \text{“}\ ) \\
(3.) & & 3; & -(\Delta_C n - \Delta_S n) - (\Delta_C z - \Delta_S z) & = +0.19 & (2\ \text{“}\ ) \\
 & & 5; & -(\Delta_C n - \Delta_S n) + (\Delta_C z - \Delta_S z) & = +0.40 & (3\ \text{“}\ )
\end{array}$$

Assuming the preceding corresponding values of $(\Delta_C n - \Delta_P n)$ and $(\Delta_C n - \Delta_S n)$ and $\Delta_C z$ for zenith stars $= +0''.24$,

$$\begin{array}{llll}
(1.) & \Delta_C z + \Delta_P z = +0''.33 & \Delta_P z = +0''.09 & \multirow{3}{*}{} \\
(2.) & \Delta_C z - \Delta_P z = -0.07 & = +0.31 & \\
 & \Delta_C z + \Delta_P z = +0.14 & = +0.20 &
\end{array}$$

$$\left.\begin{array}{r} \Delta_P z = +0''.09 \\ = +0.31 \\ = +0.20 \end{array}\right\} = +0''.18$$

$$\begin{array}{ll}
(3.) & \Delta_C z - \Delta_S z = +0.14 \\
 & \Delta_C z - \Delta_S z = +0.07
\end{array} \qquad \left.\begin{array}{r} \Delta_S z = -0.10 \\ = -0.17 \end{array}\right\} = -0''.14$$

Here $\Delta_S z$ is undoubtedly peculiar to zenith stars; $\Delta_C z$ and $\Delta_P z$ may be from the very constrained position of the observers. Considering them as the same for all stars, and $\Delta_S z = 0$ for zenith stars, these equations combined with those for other stars give,

$$\begin{array}{llcl}
(1.) & \Delta_C z = +0''.16 & \qquad & \Delta_P z = +0''.17 \\
(2.) & = +0.14 & & \Delta_P z = +0.30 \\
(3.) & = +0.20 & & \Delta_S z = +0.34
\end{array}$$

Such a constant error in determining the nadir-point affects directly all the determinations of declination or latitude, according as either is assumed. It may be determined or eliminated by the observer's reversing the position of his eye at the eye-piece.

A constant error in the bisection of a star will affect with opposite signs declinations derived from direct observations and those by reflection: the discordance between the results of these two kinds of observation will consequently be twice that error. It also enters directly into the determinations of zenith points from north and from south stars, and will produce twice the discordance between the results from each. Such discordances have been often noticed in the works of other observatories, and may be attributed in part at least to such a source.

OBSERVATIONS OF PROSERPINE, CLIO, THE THIRD COMET OF 1853, AND THETIS,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Minor.]

[Corrected for refraction.]

PROSERPINE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉖ — * Δα	㉖ — * Δδ	㉖'s apparent α	㉖'s apparent δ	A.
1853.	h. m. s			m. s.	′ ″	h. m. s	° ′ ″	
July 7	9 18 39.5	4	Weisse XIII. 813	—1 2.26	— 6 7.02	13 46 39.27	—11 36 11.35	8
	10 28 35.4	4	" 813	—1 0.12	— 6 22.95	13 46 41.40	11 36 27.29	8
8	9 55 50.5	6	" 808	+0 2.64	+ 2 8.53	13 47 23.99	11 41 25.42	10
	9 49 22.5	11	" 813	—0 18.03	—11 20.67	13 47 23.58	11 41 24.98	10
9	8 55 19.2	15	" 808	+0 45.08	— 2 50.42	13 48 6.42	11 46 24.31	10
13	9 56 5.4	2	" 893	—0 55.93	— 8 49.59	13 51 17.91	12 8 21.24	5
23	9 41 1.0	4	" 1037	+1 38.36	+15 38.07	14 0 27.92	13 7 58.84	8
24	8 43 11.6	6	" 1037	+2 37.01	+ 9 32.44	14 1 26.56	—13 14 4.42	8

At the last observation the asteroid was scarcely visible. It was looked for again on the 5th and 6th of September, both nights being quite clear, without success.

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h m. s	° ′ ″	
Weisse XIII. 813	8	13 47 31.05	—11 29 4.78	Weisse's Catalogue.
" 808	8.9	13 47 10.88	11 42 34.42	
" 893	9	13 52 3.37	11 58 33.13	
" 1093	9	13 58 39.09	—13 22 38.92	

Note. — Weisse XIII. 718. The declination should be +10° 35′ 21″ 2, instead of —10° 35′ 21″.2. The star is 935 of Santini's Catalogue, and of Bessel's Zones 79, 5.

CLIO.

Date.	M. T. Washington.	No. of Comp.	Comparison Star.	⑫ — * Δα	⑫ — * Δδ	⑫'s apparent α	⑫'s apparent δ	A.
1853.	h m. s			m s	′ ″	h. m s	° ′ ″	
April 21	11 9 58.4	12	B. A. C. 4814	—2 50.37	+ 6 6.74	14 23 45.47	—19 41 32.58	10
27	11 28 19.5	7	Lalande 26293	—1 53.12	+13 23.03	11 18 9.25	18 47 23.93	10
28	10 51 9.4	10	" 26293	+0 57.51	+22 35.86	14 17 13.65	18 38 11.17	9
30	10 34 36.0	8	" 26210	+2 38.81	+15 13.05	14 15 21.26	18 19 8.83	10
May 2	10 44 41.6	12	" 26172	+2 7.12	— 8 42.72	14 13 27.71	17 59 28.83	10
3	11 1 56.6	16	" 26172	+1 10.41	+ 1 22.78	11 12 30.71	17 49 23.30	10
9	11 28 12.5	12	" 26051	+0 51.19	— 1 46.76	14 7 2.88	16 48 15.26	10
11	12 4 4.1	6	Arg. Zones 206, 32	+2 6.53	— 7 57.34	14 5 19.48	16 27 25.59	10
13	11 32 8.6	13	" "	+0 29.75	+12 2.96	14 3 42.71	16 17 25.67	10
15	10 39 56.3	12	B. A. C. 4700	—0 38.75	—11 38.27	14 2 11.59	15 48 6.23	10
20	11 8 0.1	7	Weisse XIII. 974	+2 31.61	—12 36.08	13 58 42.43	14 59 14.93	10
31	10 36 52.4	6	" 866	+2 55.65	— 0 41.79	13 53 32.39	13 25 2.38	10
		6	Lalande 25762	—1 7.46	+13 49.96	13 53 32.02	13 24 57.11	10
June 1	9 21 16.8	4	Weisse XIII. 866	+2 39.81	+ 6 23.29	13 53 16.59	13 17 57.28	10
13	11 43 53.8	13	" 893	+0 13.16	— 4 56.73	13 52 27.19	12 4 29.91	8
15	10 2 22.5	12	" 893	+0 32.79	+ 3 38.86	13 52 46.86	11 55 51.25	9
16	9 36 41.5	5	" 893	+0 15.51	+ 7 42.55	13 52 59.57	11 51 50.55	7
26	8 56 39.5	3	" 1071	—3 45.01	—15 28.15	13 56 52.86	11 23 20.31	8
	9 3 6.9	10	" 979	+0 31.17	+ 2 5.11	13 56 52.71	—11 23 17.02	8

Adopted Mean Places, 1850.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 4814	7	14 26 24.64	—19 16 10.89	α from B. A. Cat. ; δ Washington Mural.
Lalande 26293	8	14 16 4.95	18 59 50.19	Lalande's Catalogue.
" 26210	8	14 12 31.28	18 38 31.70	" "
" 26172	(7.8)	14 11 9.16	17 49 41.94	" "
" 26054	8	14 5 57.61	16 45 29.57	" "
Arg. Zones 206, 32	8	14 3 1.89	16 18 29.26	Argelander's Zones.
B. A. C. 4700	(5.6)	14 2 39.31	15 35 28.60	British Association Catalogue.
Weisse XIII. 974	9	13 55 59.57	14 15 38.45	Weisse's Catalogue.
" 866	8	13 50 25.92	13 23 19.69	" "
Lalande 25762	9	13 51 28.61	13 37 16.68	Lalande's Catalogue.
Weisse XIII. 893	9	13 52 3.35	11 58 33.13	Weisse's Catalogue.
" 979	8	13 56 10.88	11 21 23.26	
" 1071	7	14 0 27.23	—11 6 53.96	

COMET, 1853, III.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	☄ — * Δα	☄ — * Δδ	☄'s apparent α	☄'s apparent δ	A.
1853.	h. m. s.			m. s.	′ ″	h m. s.	° ′ ″	
July 28	8 52 58.3	8	B. Z. 407, 118	+1 19.72	— 4 49.14	10 35 21.52	+37 12 30.64	7
30	8 44 59.6	8	*x*	—0 22.27	+10 12.84			8
	8 51 41.9	5	B. Z. 499, 123	—1 29.08	+ 5 26.16	10 39 29.52	36 46 36.15	8
Aug. 6	8 44 44.3	6	" 499, 138	—0 57.81	— 3 58.57	10 54 56.28	34 56 59.09	8
(1) 7	8 27 58.0	12	(7)	—0 1.96	+ 2 44.70	10 57 17.14	34 38 11.09	7
8	8 33 28.3	4	B. Z. 357, 23	—5 42.99	+ 3 19.40	10 59 37.87	34 18 9.13	8
9	8 6 51.4	9	" 357, 23	—3 23.26	—17 27.97	11 1 57.67	33 57 21.62	10
(2) 10	8 0 22.7	8	" 357, 21	+2 25.86	+15 20.34	11 4 20.64	33 35 2.30	10
	8 9 17.6	3	" " 22	+0 12.42	+ 9 58.98	11 4 20.99	33 34 49.61	10
11	7 59 21.6	6	" " 21	+4 50.47	— 8 29.48	11 6 45.27	33 11 12.34	10
	8 3 7.2	5	" " 22	+2 36.75	—13 45.05	11 6 45.32	33 11 7.46	10
(3) 12	8 21 49.3	9	" 501, 107	+1 56.67	—12 24.51	11 9 13.98	32 45 15.74	10
13	7 47 41.4	14	B. A. C 3851	+1 15.55	— 2 41.52	11 11 35.94	32 18 54.42	10
14	7 58 3.0	6	B. Z. 501, 120	—2 49.35	+ 0 13.91	11 14 2.12	31 48 14.18	10
(4) 19	8 27 47.0	4	B. A. C. 3937	—2 48.72	+ 5 52.42	11 25 41.33	28 41 33.28	10
(5) 20	7 33 59.2	7	B. Z. 526, 101	—0 48.24	+ 7 54.42	11 27 46.51	27 55 17.91	10
(6) 21	7 41 24.1	5	" 500, 130	—2 44.89	+ 3 45.72	11 29 45.46	27 1 53.42	10
(7) 22	7 33 1.9	7	" 503, 2	+2 47.31	+13 6.25	11 31 32.32	26 3 39.98	10
23	7 21 11.7	8	" 503, 11	—3 1.27	+12 17.91	11 33 6.34	25 1 50.84	8
(8) 26	7 19 45.2	4	B. A. C. 3990	—4 30.32	— 5 12.32	11 35 53.19	20 57 0.38	8
	7 26 53.4	6	B. Z. 496, 73	—1 50.04	+14 6.14	11 35 53.24	20 56 32.88	8
(9) 28	7 23 19.5	6	Rumker 3715	—0 51.04	+16 30.92	11 35 20.91	17 24 46.84	10
(10) 29	7 16 20.7	3	B. A. C. 3995	—7 25.62	— 1 52.41	11 34 8.00	+15 21 47.86	10

(1) The star of comparison not satisfactorily determined.

(2) Angle of position of coma 320°.

(3) Diameter of nucleus 10″.5.

(4) (5) Observations by Professor HUBBARD.

(6) Diameter of nucleus 11″.4.

(7) Diameter of nucleus 15″.0. The edges of the coma near the nucleus well defined and fibrous.

(8) Diameter of nucleus 11″.5. Angle of position of coma 287° 54′.

(9) Comet visible at 6h. 40m. M. T. Washington. Angle of position of coma 292° 24′.

(10) Diameter of nucleus 16″.9. Angle of position of coma 292° 40′.

Adopted Mean Places, 1850.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.	No. of Obs.
		h. m s.	° ′ ″		
B. Z. 407, 118	8.9	10 33 51.85	+37 18 9.21	Bessel's Zones.	
“ 499, 123	9	10 40 48.73	36 42 0.13		
“ 499, 138 “ 357, 19	9	10 55 45.53	35 1 50.16		
“ 357, 23	7	11 5 11.35	34 15 42.57		
(7)	(9.10)	10 57 9.52	34 36 18.90	Washington Equatorial.	2
B. Z. 357, 21	7	11 1 45.19	33 20 35.01	Bessel's Zones.	
“ 357, 22	9	11 3 58.99	33 25 43.75		
“ 501, 107	9	11 7 7.77	32 58 33.84		
(1) B. A. C. 3851	4.5	11 10 10.88	32 22 29.79	B.A.C.; Struve's Cat. Generalis; Rümker.	
B. Z. 501, 120	9	11 16 42.03	31 48 54.49	Bessel's Zones.	
B. A. C 3937	6	11 28 23.72	28 36 36.22	B. A. C., and Rümker's Catalogue.	
B. Z. 526, 101	8	11 28 25.46	27 48 19.05	Bessel's Zones.	
“ 500, 130	8	11 32 21.07	26 59 5.50		
“ 503, 2	7.8	11 28 25.71	25 51 29.67		
“ 503, 11	7	11 38 58.46	24 50 29.17		
B. A. C. 3990	4	11 40 14.60	21 3 9.61	B. A. C., and Rümker's Catalogue.	
B. Z. 496, 73	8	11 37 34.06	20 43 23.65	Bessel's Zones.	
Rümker 3715	7	11 36 2.71	17 9 12.97	Rümker's Catalogue.	
B. A. C. 3995	2.3	11 41 24.41	+15 21 38.12	Greenwich 12-Year Catalogue.	

(1) This star is double; the preceding star is used. STRUVE's determination is of the following star, from which the place of the preceding has been reduced with $\Delta = 2''.0$, $P = 156°$.

THETIS.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑰ — *		⑰'s apparent	
				Δα	Δδ	α	δ
1853.	h. m. s			m. s.	′ ″	h. m. s.	° ′ ″
Sept. 8	9 5 16.9	6	Weisse XXIII. 377	+2 44.34	—9 20.96	23 21 45.61	—10 59 37.72
	9 9 17.0	5	“ 423	+0 27.73	—5 19.04	23 21 45.35	10 59 42.14
		5	“ 463	—1 31.70	—1 57.21	23 21 45.37	—10 59 38.84

Adopted Mean Places, 1850.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h m. s.	° ′ ″	
Weisse XXIII. 377	8.9	23 18 49.47	—10 51 30.43	Weisse's Catalogue.
“ 423	9	23 21 5.85	10 55 37.05	
“ 463	9	23 23 5.34	—10 58 55.72	

The asteroid is of the 10.6 magnitude.

ON THE DEVIATION OF FALLING BODIES TO THE SOUTH OF A PERPENDICULAR.

By HUBERT A. NEWTON.

IF a heavy body be let fall from any height, the impulse which it derives from the rotation of the earth upon its axis would cause it to describe a straight line perpendicular to the meridian plane of the place. The attraction of gravitation (supposing the earth to be a sphere) would cause the body to describe an ellipse about the earth's center. This ellipse will lie in the prime vertical, since the projectile velocity and the force of attraction are both in that plane. The falling body will therefore meet the earth's surface in the great circle formed by its intersection with the prime vertical. The place directly beneath that from which the body has fallen would meanwhile have moved in the small circle of the parallel of the place. The body must therefore fall to the south of the perpendicular in north latitudes, and north of it in south latitudes.

If we describe upon the earth's surface a right-angled triangle, of which the polar distance of the place is one leg, and the angle of rotation of the earth during the time of falling is the oblique angle at the pole, the hypothenuse will express with sufficient accuracy the polar distance of the body after it has fallen. The difference of the two polar distances will be the deviation in question.

Making the earth's radius unity, the hypothenuse α, the angle at the pole β, and the perpendicular γ, we have

$$\cos\beta = \frac{\operatorname{tang}\gamma}{\operatorname{tang}\alpha},$$

hence

$$1 - \cos\beta = \frac{\operatorname{tang}\alpha - \operatorname{tang}\gamma}{\operatorname{tang}\alpha},$$

or

$$2\sin^2\frac{\beta}{2} = \frac{\sin(\alpha-\gamma)}{\sin\alpha\cos\gamma}.$$

But for small values of β we may substitute $\sin\gamma$ for $\sin\alpha$ without material error.

Hence,

$$\sin(\alpha-\gamma) = \sin 2\gamma \sin^2\frac{\beta}{2}.$$

Representing the time of fall in seconds by t, the earth's radius by R, the deviation, or $R(\alpha-\gamma)$, by Δ, we have $\beta = 15\,t$, and may put from the above equation

$$\Delta = \tfrac{225}{4}\,R\,t^2\sin^2 1''\sin 2\gamma.$$

Making $R = 3960$ miles, $t = \frac{2h}{g}$, and $g = 32.1908$ feet, we have $\Delta = .0017175\,h\sin 2\gamma$, in which equation h represents the height from which the body falls, and γ either the polar distance or the latitude of the place.

This determination supposes the earth to be a sphere. But the center of attraction is neither at the earth's center, nor in the prime vertical. Its locus for all points of the same parallel is a small circle near the earth's center, and all the lines drawn from points in a parallel to their corresponding centers of attraction will meet in the earth's axis. This point may for our present purpose be considered as the center of force, for the force is always directed toward it. If now a sphere be described from this point as a center, with a radius (ϱ) equal to its distance from any point of the parallel, the earth's surface and that of the sphere will intersect in the parallel, and for a small distance on either side will very nearly coincide with each other. The body does not materially change its latitude, and we may therefore in the expression obtained above substitute ϱ for the earth's radius.

But since the centrifugal force causes the prime vertical to make an angle with the plane in which the body moves, the point under that from which the body falls is nearer the equator than the latter plane by a distance equal to $h\,\delta$, if δ represents the measure of the angle of inclination of the two planes. The whole variation of the falling body from the perpendicular is therefore $\frac{\varrho\,\Delta}{R} - h\,\delta$, in which γ represents the latitude of the place measured upon the sphere.

NEW COMET.

Professor Petersen informs me that a large, faint nebulous comet resembling a star-cluster was detected near the forward paw of the *Great Bear* on the night of September 11, by Mr. C. Bruhns in Berlin.

Its position was determined by observations at the Berlin Observatory : —

1853.	Berlin M. T. h m. s.	☄ α	☄ δ
Sept. 11	13 12 15.3	126° 59′ 11″.5	+11° 51′ 33″.6
	14 58 27.8	127 4 46.1	+11 49 21.8

The apparent place adopted for the comparison-star was

	✻ α	✻ δ
Arg. Z. 88,144	127° 14′ 28″.8	+11° 50′ 23″.0

Hence the daily motion of the comet would be

+1° 27 in α ; —0° 30′ in δ.

G.

FOURTH COMET OF 1853.

I AM indebted to Professor PETERSEN for farther information, dated September 20, concerning this comet. Mr. BRUHNS had observed it at Berlin as follows: —

1853.	M. T. Berlin. h. m. s.	☄ α	☄ δ	No. Comp.	
Sept. 12	13 50 25.6	128° 18′ 55″.2	+44° 19′ 8″.1	10	*b*
13	12 6 31.0	129 33 3.7	43 47 17.4	10	*c*
14	12 55 15.2	130 58 37.0	43 9 2.9	10	*d*
15	12 13 53.8	132 22 8.9	+42 29 51.5	10	*e*

Adopted Mean Places, 1853.0, *of Comparison-Stars.*

	✱ α	✱ δ	Authority.
b	128° 48′ 44″.3	+44° 10′ 42″.3	B. Z. 494; Lalande 17141
c	129 45 26.0	43 41 4.9	" " " 17269
d	130 19 50.9	43 7 57.9	" " " 17340
e	132 46 25.0	+42 21 45.8	" 455; Taylor 3908

From the observations of September 11, 13, 15, he had deduced elements and an ephemeris, which, however, owing to the disadvantageous position of the comet, he considers as being only a tolerable approximation.

T	Oct. 16^d.6122
π	301° 23′ 20″.4
☊	222 13 44.1
i	63 6 5.1
Log. *q*	9.200658

Motion Retrograde.

These elements represent the middle place with the following errors: —

	C. − O.
$\Delta\lambda$	+1″.7
$\Delta\beta$	+2.3

Ephemeris for Mean Berlin Noon.

1853.	☄ α h. m. s.	☄ δ	Log △	Brilliancy.
Sept. 25	9 54 57	+32° 13′	9.9154	5
26	10 3 14	30 32		
27	11 49	28 41		
28	20 42	26 40		
29	29 54	24 29	9.8661	9
30	39 22	22 7		
Oct. 1	49 6	19 35		
2	10 59 6	16 52		
3	11 9 22	14 0	9.8318	14
4	19 51	10 58		
5	30 31	7 19		
6	11 41 23	+4 35		
Oct. 7	11 52 24	+ 1° 21′	9.8300	23
8	12 3 30	− 1 52		
9	14 38	5 2		
10	25 45	8 2		
11	12 36 48	10 44	9.8747	39
15	13 18 22	17 53	9.9642	66
19	13 48 26	−16 6	0.0519	37

No indications of a tail were visible up to September 17, and the nucleus had from the first presented the appearance of an unresolved nebula, with numerous points of light.

Mr. RÜMKER has also observed the comet at Hamburg.

1853.	M. T. Hamburg. h. m. s.	☄ α	☄ δ	No. Comp.
Sept. 13	14 2 5.2	129° 40′ 19″.8	+43° 44′ 7″.7	9
14	14 36 24.6	131 5 23.4	43 5 55.3	5
15	14 9 20.5	132 29 43.0	42 26 23.3	14
17	14 6 34.2	135 31 22.7	+40 51 5.0	15

Apparent Places adopted for Comparison-Stars.

	✱ α h. m. s.	✱ δ
Sept. 13	8 39 1.99	+43° 40′ 59″.3
14	8 41 19.79	43 7 53.2
	42 9.40	42 58 24.2
15	8 51 5.25	42 21 36.7
16	9 1 51.19	+40 53 41.5

Mr. RÜMKER states that the comparison-star of September 13 has a companion, mentioned neither by LALANDE nor BESSEL. The place given by each of these observers is that of the more southerly and brighter star.

G.

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ON THE LIMIT TOWARD WHICH A CERTAIN SERIES CONVERGES.

By Dr. JULIUS FRIEDLÄNDER
OF BERLIN.

The sum of the series

$$1+\frac{1}{2^{1+\varrho}}+\frac{1}{3^{1+\varrho}}+\frac{1}{4^{1+\varrho}}+\ldots\ldots \text{ in inf. for } \varrho=0.$$

There is commonly no attention paid to *divergent series*, and their divergence once stated, they are not any more investigated. But in order to use them in analytical researches they ought to be classified. For this purpose it seems to be the best method to compare them to the different orders of infinite expressions, as

$$\frac{1}{\varrho},\ \frac{1}{\varrho^2},\ \frac{1}{\varrho^3}\ \ldots\ldots \text{ for } \varrho=0.$$

I will show this for one of the most known and interesting series. To find the sum of the series

$$1+\frac{1}{2^{1+\varrho}}+\frac{1}{3^{1+\varrho}}\ \ldots\ldots \text{ for } \varrho=0.$$

Let us express the series by a definite integral, by help of the formula

$$\frac{1}{K^{1+\varrho}}=\frac{1}{\Gamma(1+\varrho)}\int_0^\infty x^\varrho\, e^{-kx}\, dx.$$

Then there will be,

$$1+\frac{1}{2^{1+\varrho}}+\frac{1}{3^{1+\varrho}}+\ldots\ldots=\frac{1}{\Gamma(1+\varrho)}\int_0^\infty x^\varrho\,[e^{-x}+e^{-2x}\ \ldots\ldots]\, dx.$$

$$=\frac{1}{\Gamma(1+\varrho)}\int_0^\infty \frac{x^\varrho}{e^x-1}\, dx.$$

This integral always has a finite value as long as

$$\varrho>0.$$

ϱ may be as small as you like, but for $\varrho=0$ it becomes infinite. We can demonstrate now, that if the integral for $\varrho=0$ be taken between α and ∞, instead of taking it between the limits 0 and ∞, where α represents an arbitrarily small positive value, that

$$\int_\alpha^\infty \frac{dx}{e^x-1} \text{ has always a finite value.}$$

There is namely at first

$$\int_\alpha^1 \frac{dx}{e^x-1} \text{ finite,}$$

because it lays between

$$(1-\alpha)\ \frac{1}{e-1} \text{ and } (1-\alpha)\ \frac{1}{e^\alpha-1}$$

and further

$$\int_1^\infty \frac{dx}{e^x-1}<\int_1^\infty x^\varrho \frac{dx}{e^x-1} \text{ because}$$

$$\text{for } x\geqq 1 \text{ there is } x^\varrho \geqq 1$$

and therefore certainly finite.

If, therefore, instead of writing $S=\int_0^\infty x^\varrho \frac{dx}{e^x-1}$

you write $S=\int_0^\alpha x^\varrho \frac{dx}{e^x-1}$

the error consists only in a finite quantity, how small soever you assume α.

Inasmuch now as

$$\frac{1}{e^x-1}=\frac{1}{x+\frac{x^2}{2}+\frac{x^3}{6}\ \ldots\ldots}$$

can be reduced to the form

$$\frac{1}{x}\,(1+p\,x+q\,x^2\ldots\ldots)$$

we see that the quantity $\frac{x}{e^x-1}$ approaches so much nearer unity as we suppose x smaller, or that

$$\lim^{x=0}\left(\frac{x}{e^x-1}\right)=1.$$

We reduce. therefore, the integral S to the form

$$S = \int_0^{\alpha} x^{\varrho-1} \cdot \frac{x}{e^x-1}\, dx.$$

The coefficient $\frac{x}{e^x-1}$ diminishes from 1 to $\frac{\alpha}{e^\alpha-1}$. Then if β and β' be between 0 and α, and $\beta' > \beta$, we shall have,

$$1 + \frac{\beta'}{2} + \frac{\beta'^2}{6} + \ldots\ldots > 1 + \frac{\beta}{2} + \frac{\beta^2}{6} + \ldots\ldots$$

i. e.

$$\frac{e^{\beta'}-1}{\beta'} > \frac{e^{\beta}-1}{\beta}$$

consequently,

$$\frac{\beta'}{e^{\beta'}-1} < \frac{\beta}{e^{\beta}-1}$$

If, therefore, δ represents an unknown value between $\frac{\alpha}{e^\alpha-1}$ and 1, we shall find

$$S = \delta \int_0^{\alpha} x^{\varrho-1}\, dx. = \delta\, \frac{\alpha^\varrho}{\varrho}.$$

Let now α, and at the same time ϱ, converge towards the limit 0, then δ will converge towards unity, $\frac{\alpha^\varrho}{\varrho}$ towards $\frac{1}{\varrho}$, and $\Gamma(1+\varrho)$ towards $\Gamma(1)$; consequently we shall find as limit of the series

$$\lim^{\varrho=0}\left(1 + \frac{1}{2^{1+\varrho}} + \frac{1}{3^{1+\varrho}} \ldots\ldots\right) = \lim^{\varrho=0}\left(\frac{1}{\varrho}\right).$$

LETTER FROM PROFESSOR ALEXANDER TO THE EDITOR.

Princeton, N. J., 1853, *October* 13.

THE approximate elements of the orbit of Comet IV. of 1853, as computed by Mr. BRUHNS (*Astron. Journ.*, No. 64) agree very well with those of the comet of 1582, as computed by Mr. PINGRÉ from the observations of TYCHO (*Cometographie*, Tom. I. pp. 549, 550). Mr. PINGRÉ does not regard the determination of this last-mentioned orbit as very exact; the comet having been visible for but a short time, and its apparent motion not very rapid. Yet when the corrections for precession are applied to 1853, September 13, and the time of the perihelion passage is reduced to the new style, the elements of the orbit in comparison with those of 1853, IV. read as follows: —

T	1582^y.374	T	1853^y.790
π	249° 10′ 16″	π	301° 23′ 20″.4
☊	234 54 26	☊	222 13 44.1
i	61 27 50	i	63 6 5.1
Log. q	9.353522. $q = 0.225695$	Log. q	9.200658. $q = 0.158730$
	Motion Retrograde.		Motion Retrograde.

M. PINGRÉ has given a second set of elements of the comet of 1582, dependent upon some small changes in the data. Corrected as before, they read as follows: —

T	1582^y.375
π	285° 13′ 51″
☊	218 29 41
i	59 29 5
Log. q	8.602754. $q = 0.040064$

Of the two sets of elements, the former would seem to be the more reliable, and they also agree better with those of the other comet. Admitting the identity of the two bodies, the periodic time, in so far as such a comparison can determine it, would appear to be $271\frac{4}{10}$ years. No intermediate return seems to have been observed.

The comet of 1582, after its perihelion passage, was a much more conspicuous object than that now visible promises to be. The circumstances under which the former was seen were, however, somewhat more favorable.

STEPHEN ALEXANDER.

OBSERVATIONS OF THETIS, AND OF THE THIRD AND FOURTH COMETS OF 1853, MADE AT THE HAMBURG OBSERVATORY.

By PROFESSOR C. RÜMKER.

THETIS.

1853.	M. T. Hamburg. h. m. s.	⑰ α	Log. Fact. Parall.	⑰ δ	Log. Fact. Parall.	No. Comp.
Aug. 10	12 7 34.9	355 31′ 6″.4		—7° 21′ 51″.0		3
11	11 55 9.2	355 24 45.7	n9.5499	7 28 45.1	9.9345	11
12	12 3 53.3	355 17 58.5				10
25	10 25 50.4	353 20 53.2	n9.6136	9 9 33.8	9.9355	11
27	9 53 28.5	352 58 34.0	n9.6568	9 24 44.5	9.9326	8
28	9 57 21.0	352 46 59.2	n9.6420	—9 32 51.0	9.9342	11

Apparent Places of Comparison-Stars.

1853.	✱ α	✱ δ	1853.	✱ α	✱ δ
	h. m. s.	° ′ ″		h m. s.	° ′ ″
Aug. 10	23 41 1.28	−7 11 30.8	Aug. 25	23 33 50.92	−9 26 24.9
	23 41 15.24	7 25 33.4	27	23 30 39.07	9 26 9.4
11	23 44 19.32	7 25 34.6	28	23 28 27.38	−9 34 25.1
12	23 44 15.26	−7 25 33.3			

COMET 1853, III.

1853.	M. T. Hamburg.	☄ α	Log. Fact. Parall.	☄ δ	Log. Fact. Parall.	No. Comp.
	h. m. s.	° ′ ″		° ′ ″		
June 13	13 3 14.5	143 29 42.3		+43 10 37.7		
23	11 19 37.7	145 39 2.0		42 9 23.1		
25	11 15 53.7	146 9 46.5		41 56 17.6		
28	11 21 28.9	146 59 35.3		41 36 24.4		
29	10 52 30.3	147 16 28.6		41 29 51.9		6
30	11 7 27.2	147 34 27.1		41 22 44.5		14
July 1	11 2 13.3	147 52 35.1		41 15 50.1		16
2	11 8 5.1	148 11 7.9		41 8 49.5		10
3	10 59 43.4	148 30 0.3		41 1 40.9		10
8	11 20 40.0	150 11 32.3		40 24 29.6		12
11	11 1 23.7	151 17 10.9		40 1 7.5		14
15	10 39 27.3	152 50 31.9		39 27 47.9		4
19	10 21 4.5	154 31 8.0		38 51 41.7		4
20	10 34 9.1	154 57 46.9		38 42 6.4		5
23	10 15 9.1	156 18 52.3		38 11 43.7		9
27	10 38 50.7	158 15 9.4	9.7785	37 26 36.7	9.9322	6
28	9 54 36.3	158 41 29.8	9·8272	37 14 53.8	9.9026	8
31	10 1 59.9	160 17 56.7	9.8104	36 35 37.6	9.9138	6
Aug. 2	10 2 44.9	161 22 36.6	9.8029	36 6 26.7	9.9179	6
4	10 27 34.0	162 29 51.9	9.7635	35 31 58.1	9.9371	2
5	9 51 40.4	163 3 3.3	9.8050	35 18 21.3	9.9154	9
7	9 11 55.0	164 11 37.4	9.8337	34 42 12.7	9.8900	1
8	9 45 5.1	164 47 37.9	9.8019	34 22 4.6	9.9162	5
9	9 38 50.6	165 23 15.3	9.8049	34 1 16.1	9.9137	8
10	10 4 24.7	165 59 37.6	9.7720	33 38 44.5	9.9318	3
11	9 9 58.6	166 34 23.3	9.8232	33 15 54.5	9.8971	6
12	9 10 1.0	167 10 40.7	9.8200	32 50 45.1	9.8992	4
14	9 4 21.0	168 23 4.8	9.8175	31 55 24.1	9.8995	3
17	9 26 6.0	170 11 8.5	9.7872	30 13 29.2	9.9201	3
18	9 9 44.0	170 45 20.9	9.7977	29 34 25.2	9.9120	1
21	8 42 36.7	172 20 27.3	9.8040	27 12 49.8	9.9030	1
23	8 42 27.4	173 12 20.5	9.7935	25 11 55.9	9.9089	3
25	8 46 14.0	173 48 17.3	9.7787	22 41 59.0	9.9168	3
26	8 27 0.0	173 57 31.5	9.7850	21 15 15.7	9.9106	1
28	8 4 16.4	173 52 48.3	9.7838	+17 49 26.0	9.9077	1

Apparent Places of Comparison-Stars.

1853.	✱ α	✱ δ	1853.	✱ α	✱ δ
	h. m. s.	° ′ ″		h. m. s.	° ′ ″
June 13	9 34 7.27	+43 24 4.6	June 29	9 49 23.83	+41 26 40.1
23	9 42 14.80	42 12 15.0	30	9 50 43.51	41 24 27.6
	43 40.82	9 10.1	July 1	9 50 21.57	41 16 25.5
25	9 46 55.02	41 58 23.2	2	9 50 43.50	41 21 28.2
28	9 48 26.03	41 53 41.6	3	9 55 35.19	41 22 33.6
	48 39.41	+41 45 23.8	8	10 2 0.28	+40 5 40.3

1853.	✱ α h. m. s.	✱ δ ° ′ ″
July 11	10 4 56.06	+40 4 0.2
15	10 13 21.35	39 12 59.0
	15 24.42	46 48.4
19	10 15 38.92	38 52 9.7
20	10 16 24.03	38 45 59.4
23	10 28 37.70	38 59 29.4
27	10 27 54.15	37 5 24.8
28	10 34 1.76	37 17 18.4
31	10 41 49.72	36 52 35.3
	42 50.92	37 11.4
Aug. 2	10 48 51.70	35 59 0.6
	49 46.46	56 49.1
4	10 49 37.27	35 24 50.3
5	10 52 18.98	35 15 22.7
7	10 46 47.04	34 49 5.8
8	11 5 20.99	+34 14 49.7
Aug. 9	11 5 20.99	+34 14 49.6
10	11 10 31.59	33 53 50.3
	11 36.86	37 40.3
11	11 11 54.85	33 19 43.1
12	11 12 48.86	32 32 26.7
	13 41.05	50 59.0
	14 57.60	38 10.7
14	11 10 19.88	32 21 27.2
	23 50.38	31 47 4.8
17	11 24 38.97	29 51 45.2
18	11 23 8.47	29 15 46.8
21	11 18 54.82	27 12 9.7
23	11 36 7.51	24 49 34.8
25	11 34 26.52	23 1 44.5
26	11 40 23.81	21 2 6.7
28	12 7 44.85	+17 43 31.0

COMET 1853, IV.

1853.	Hamburg M. T. h. m. s.	☄ α ° ′ ″	☄ δ ° ′ ″	No. Comp.
Sept. 13	14 2 5.2	129 40 19.8	+43 41 7.7	9
14	14 36 24.6	131 5 23.4	43 5 55.3	5
15	14 9 20.5	132 29 43.0	42 26 23.3	14
17	14 6 34.2	135 31 22.7	40 54 5.0	15
19	13 54 15.3	138 45 42.6	39 4 30.8	4
21	14 1 31.0	142 17 39.3	36 52 18.6	15
24	14 52 34.2	148 10 16.7	+32 39 2.2	15

Apparent Places of Comparison-Stars.

1853.	✱ α h. m. s.	✱ δ ° ′ ″
Sept. 13	8 39 1.99	+43 40 59.3
14	8 41 19.79	43 7 53.2
	42 9.40	42 58 24.2
15	8 51 5.25	42 21 36.7
17	9 1 51.69	+40 53 41.5
Sept. 19	9 11 46.15	+38 48 23.5
	14 6.95	58 11.1
	14 36.25	39 2 48.1
21	9 26 31.50	36 56 28.7
24	9 52 31.98	+32 38 36.8

FROM A LETTER OF PROFESSOR RÜMKER TO THE EDITOR.

Hamburg Observatory, 1853, *September* 27.

At Liverpool in England a remarkable luminous appearance was observed, September 2, over that part of the horizon where the comet had set a couple of hours previous. By part of the inhabitants it was supposed to be a comet, but it was generally ascribed to an *Aurora Borealis*. At Durham on the same evening a luminous streak like the tail of a comet was seen extending above the horizon in the same direction, and the surrounding part of the heavens was seen in a glare of light and attributed to an aurora. At Rundhoff in Angela (Schleswig), about 9^{h} 45^{m} P. M., a phenomenon resembling the tail of a comet was observed in the west-southwest, extending 45° above the horizon, inclining toward the south with the concave side southward, and spreading like a fan, and at about $11^{h.}$ a splendid aurora was seen in the north. At Hamburg, at $9^{h.}$ $15^{m.}$, the same appearance was remarked in the west-northwest, inclining in precisely the same manner to the southward, and spreading above like a cloud affected by the wind. At first it covered *Arcturus*, but had a progressive motion southward of about 8° in a quarter of an hour, and inclined gradually more and more towards the horizon.

I would call attention to the circumstance that 1853, March 21, the setting of the great comet then visible was attended with the same appearances, seen at several places and generally attributed to the zodiacal light. To avoid any confusion of the *cum hoc* with the *propter hoc* I propose to compute the inclination of the Comet 1853, III. 1853, September 2, $9^{h.}\ 15^{m.}$ Hamburg mean time; assuming as data, for the sun,

$$\alpha = 10^{h.}\ 46^{m.}\ 58^{s.},\quad \delta = +7^{\circ}\ 44'\ 40'',\quad \text{Log. } R = 0.00357$$

and for the comet,

$$\alpha = 11^{h.}\ 22^{m.}\ 29^{s.},\quad \delta = +6^{\circ}\ 54'\ 0'',\quad \text{Log. } \Delta = 9.86910$$

These give

	Sun.	Comet.
Azimuth,	N. 43° 46′ W.	N. 52° 25′ W.
Distance below horizon,	19 34	16 25

Suppose now the real places of the sun and of the comet to be projected upon a plane tangent to the celestial sphere at the true west point of the horizon, we have

$$\frac{R\,.\text{sin depression } \odot - \Delta \text{ sin depression } ☄}{R\,.\text{ cos azimuth } \odot \text{ cos depr. } ☄ - \Delta \text{ cos azimuth } ☄ \text{ cos depr. } \odot}$$

= the tangent of the inclination of the tail of the comet to the horizon = 26° 48′.

Now the computed azimuth agrees perfectly with the observed one, but the computed inclination 26° 48′ differs from the observed inclination of the comet, which at that time covered *Arcturus*. But it has been frequently observed that the tails of comets are curved, and a similar curvature might have occasioned this deviation. The shortest distance from the earth of the direction of the tail, or of the line passing through the sun and comet, was 0.406688 of the earth's mean distance from the sun. And it is evident that the azimuth of the visible portion of the comet's tail must have had a gradual progression toward the south as the azimuth of the comet itself is increasing northwardly, and that the angle of the comet tail with the horizon must grow less and less.

At eleven, the sun and comet were below the horizon in the magnetic azimuth, but the comet one degree above the sun, which could produce the [appearance of the] *Aurora Borealis.* The tail of the comet was in the form of a fan, which could produce the streaks of the aurora, which spread on such occasions above the horizon.

Without venturing to ascribe every aurora to a comet, it is certain, on the other hand, that many more comets exist than are observed, many of which may pass their perihelions between the sun and the earth.

Finally, I beg to recall the fact that this comet did pass its perihelion September 3, — thus agreeing closely with the observed aurora.

C. RÜMKER.

ON THE DEVIATION OF FALLING BODIES TO THE SOUTH OF A PERPENDICULAR.

By HUBERT A. NEWTON.

The expression for the southerly deviation of falling bodies will be determined by the following reduction more correctly than by that pursued in the last number of the Journal.

We there found,

$$\sin(\alpha - \gamma) = \sin 2\,\gamma \sin^2 \frac{\beta}{2}\,.$$

Multiplying by ϱ and subtracting $h\,\delta$ gives the true variation which we represent by D; that is

$$D = \varrho \sin 2\,\gamma \sin^2 \frac{\beta}{2} - h\,\delta.$$

If f represents the centrifugal force, g' that of attraction and g the resultant; since g' makes with f an angle equal to the latitude and with g the angle δ, we have by the parallelogram of forces

$$\sin \delta = \frac{f}{g} \cos \gamma.$$

But $f = \frac{4\,\pi^2}{T^2}\,\varrho \sin \gamma$, making $T = 86164$.

Therefore

$$h \sin \delta = \varrho\,.\,\frac{4\,\pi^2}{T^2}\,.\,\frac{h}{g}\,.\sin\gamma\cos\gamma.$$

Now $\beta = \frac{2\,\pi\,t}{T}$, and putting β and δ for their sines,

$$D = \varrho\,.\,\frac{\pi^2}{T^2}\,.\,t^2 \sin 2\,\gamma - \varrho\,.\,\frac{4\,\pi^2}{T^2}\,.\,\frac{h}{g}\,.\sin\gamma\cos\gamma = \varrho \sin 2\,\gamma\,.\,\frac{\pi^2}{T^2}\left(t^2 - \frac{2\,h}{g}\right).$$

Representing the time of falling from the given height in a vacuum by t', we have $\frac{2\,h}{g} = t'^2$.

Hence $$D = \varrho\,.\,\frac{\pi^2}{T^2}\,.\sin 2\,\gamma\,(t^2 - t'^2)$$

in which expression ϱ represents the line drawn from the place through the center of the earth's attraction, and extended till it meets the earth's axis, γ the angle it makes with the axis, and t the time of falling in the atmosphere.

OBSERVATIONS OF PHOCEA, EGERIA, ASTRÆA, AND FLORA,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant MAURY.]

[Corrected for refraction.]

PHOCEA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉕ — *		㉕'s apparent	
				$\Delta\alpha$	$\Delta\delta$	α	δ
1853.	h. m. s			m. s.	′ ″	h. m. s.	° ′ ″
June 29	8 40 46.2	2	Rümker 4697	+2 0.22	— 6 37.78	14 20 28.34	+1 32 57.08
	9 36 13.0	6	"	+2 1.71	— 6 29.39	14 20 29.82	1 33 5.48
	9 39 6.4	5	B. A. C. 4798	—1 52.08	+ 3 54.60	14 20 30.10	1 33 3.33
July 4	9 9 43.4	13	"	+0 49.38	+13 13.36	14 23 11.52	1 42 22.28
	10 49 6.4	7	"	+0 51.77	+13 21.60	14 23 13.91	1 42 30.53
5	9 41 53.4	9	Rümker 4730	—0 5.03	+ 9 35.33	14 23 49.93	1 43 29.34
6	8 33 47.1	8	" 4730	+0 32.53	+10 23.15	14 24 27.48	1 44 17.22
7	8 32 36.8	5	" 4730	+1 13.56	+10 57.00	14 25 8.51	1 44 51.13
		5	" 4739	—1 17.90	+14 55.99	14 25 8.40	1 44 52.75
8	8 37 56.3	4	" 4739	—0 34.95	+15 18.17	14 25 51.36	1 45 11.99
9	9 41 6.9	6	" 4739	+0 10.63	+15 25.33	14 26 36.82	1 45 22.22
	9 41 40.8	5	" 4761	—2 28.54	+ 3 28.00	14 26 37.05	1 45 23.23
24	9 55 50.4	7	B. A. C. 4869	+2 28.90	+ 1 52.08	14 40 31.00	1 22 16.41
28	10 8 4.7	12	Rümker 4840	—0 10.01	—10 44.03	14 45 19.03	1 9 33.08
Aug. 6	10 20 15.8	8	B. A. C. 4944	+2 38.27	+ 6 30.35	14 56 56.64	0 33 8.74
7	9 25 24.5	2	"	+3 58.94	+ 2 11.22	14 58 17.33	0 28 49.65
	9 44 18.8	8	Weisse XIV. 1131	—1 40.72	— 0 17.90	14 58 19.06	0 28 38.79
	9 46 31.4	7	" 1142	—2 11.89	— 1 59.65	14 58 18.76	0 28 37.11
8	10 7 54.6	1	" 1142	—0 45.96	— 6 46.87	14 59 44.74	0 23 49.99
9	9 30 32.3	14	" 1142	+0 37.28	—11 24.63	15 1 7.96	+0 19 12.17
28	9 5 55.6	9	Weisse XV. 585	+0 23.44	— 6 25.06	15 31 29.66	—1 24 29.11
29	9 25 29.9	6	" 585	+2 10.26	—12 26.76	15 33 16.46	1 30 29.80
30	9 11 49.1	6	" 620	+2 24.76	+14 29.58	15 35 2.72	1 36 21.32
Sept. 5	9 8 4.3	5	(8)	+0 18.11	+16 11.66	15 45 59.52	2 12 18.13
6	8 41 51.0	4	(8)	+2 9.63	+10 14.87	15 47 51.02	2 18 14.89
	8 44 58.0	3	Weisse XV. 939	—1 32.73	+15 18.59	15 17 50.90	2 18 16.31
7	8 17 36.2	5	" 939	+0 18.33	+ 9 23.66	15 19 41.94	2 24 11.27
8	7 41 22.1	4	" 939	+2 9.95	+ 3 28.84	15 51 33.56	2 30 6.12
10	8 20 23.0	8	" 1092	—2 12.98	+14 23.78	15 55 28.66	2 42 10.60
11	7 48 43.3	10	" 1092	—0 19.01	+ 8 33.36	15 57 22.60	2 48 1.02
13	7 43 8.4	10	Weisse XVI. 11	—0 37.40	+ 9 22.88	16 1 17.97	2 59 56.29
		10	" 19	—0 51.74	+ 4 38.79	16 1 18.16	2 59 57.55
15	7 13 26.2	4	B. A. C. 5114	—1 23.56	+ 7 5.75	16 5 15.89	3 11 35.67
	8 25 56.1	5	"	—1 18.84	+ 6 50.56	16 5 20.60	3 11 50.86
(1) 16	7 39 33.9	8	"	+0 38.20	+ 1 19.39	16 7 18.29	3 17 22.08
(1) 17	7 31 44.9	7	"	+2 39.12	— 4 40.48	16 9 19.20	3 23 21.95
23	7 54 34.3	5	Lalande 30099	—3 54.66	— 1 7.99	16 21 45.62	3 57 46.68
24	7 22 58.6	10	"	—1 50.10	— 6 34.92	16 23 49.86	4 3 13.63
25	7 22 55.1	13	"	+0 15.99	—12 4.76	16 25 56.23	4 8 43.49
26	7 13 17.4	14	(9)	+0 38.27	— 7 46.50	16 28 2.42	4 14 7.32
Oct. 2	8 4 41.2	10	Weisse XVI. 792	—0 12.60	+ 6 59.94	16 41 10.65	4 46 7.17
3	7 18 30.8	10	"	+1 55.94	+ 2 9.69	16 43 19.18	4 50 57.45
		10	Lalande 30671	—1 23.56	+ 2 59.31	16 43 19.68	4 50 56.53
4	7 14 12.5	14	" 30671	+0 49.47	— 1 58.86	16 45 32.71	4 55 54.83
6	7 55 55.9	5	Weisse XVI. 912	+2 14.08	—10 11.57	16 50 5.92	5 5 52.58
7	6 49 9.9	4	"	+1 24.35	—14 41.36	16 52 16.19	5 10 25.41
17	7 3 29.3	6	Weisse XVII. 202	+3 15.13	— 7 48.95	17 15 23.29	5 53 0.44
18	7 4 9.5	5	" 254	+2 55.13	+13 56.54	17 17 45.11	5 56 42.78
19	7 57 0.9	3	" 409	—2 28.93	+ 2 40.21	17 20 12.44	—6 0 36.94

(1) Observations by Professor HUBBARD.

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.	No. of Obs.
		h. m s.	° ′ ″		
Rümker 4697	7	14 18 17.85	+1 40 26.19	Rümker's Catalogue.	
B. A. C. 4798	5.6	14 22 11.88	1 29 59.37	B. A. C.; Santini; Weisse; Rümker.	
Rümker 4730	8.9	14 23 44.72	1 34 44.11	Rümker's Catalogue.	
" 4739	9	14 26 16.06	1 30 46.35	" "	
" 4761	9	14 28 55.36	1 42 44.19	" "	
B. A. C. 4869	6.7	14 37 51.96	1 21 11.01	B. A. C.; Rümker; Weisse; Santini.	
Rümker 4840	9	14 45 18.91	1 21 2.16	Rümker's Catalogue.	
B. A. C. 4944	6	14 54 8.29	0 27 21.82	B. A. Catalogue, and Rümker.	
Weisse XIV. 1131	9	14 59 49.71	0 29 39.06	Weisse's Catalogue.	
" 1142	8	15 0 20.58	+0 31 19.00	" "	
Weisse XV. 585	8.9	15 30 56.12	−1 17 27.30	" "	
" 620	9	15 32 27.84	1 50 15.32	" "	
" 844	6	15 43 27.14	2 38 1.73	" "	
(8)	9.10	15 45 31.26	2 27 57.08	Washington Equat. from prec. and foll. stars.	6
Weisse XV. 939	9	15 49 13.48	2 33 3.13	Weisse's Catalogue.	
" 1093	7	15 57 31.49	2 56 4.40	" "	
Weisse XVI. 11	8.9	16 1 45.26	3 8 50.21	" "	
" 19	6	16 1 59.79	3 4 7.45	" "	
B. A. C. 5414	3	16 6 29.29	3 18 13.60	Washington Observations.	
Lalande 30099	8.9	16 25 30.09	3 56 15.50	Lalande's Catalogue, and Weisse's Cat.	
(9)	(9)	16 27 14.00	4 5 57.99	Washington Equatorial from preceding star.	9
Weisse XVI. 792	9	16 41 13.05	4 52 47.73	Weisse's Catalogue.	
Lalande 30671	8	16 44 33.02	4 53 37.35	Lalande's Catalogue, and Weisse's Cat.	
Weisse XVI. 912	9	16 47 41.65	4 55 23.26	Weisse's Catalogue.	
Weisse XVII. 202	7	17 11 57.74	5 44 59.76	" "	
" 254	8.9	17 14 39.70	6 10 28.38	" "	
" 409	9	17 22 31.09	−5 57 48.08	" "	

EGERIA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑬ − *		⑬'s apparent	
				$\Delta\alpha$	$\Delta\delta$	α	δ
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
June 2	14 25 3.1	6	(6)	−2 32.40	−11 14.90	19 6 38.73	−41 27 22.35
29	12 0 5.6	6	Brisbane 6501	−2 18.05	−16 1.26	18 38 23.00	−44 22 6.99

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ
		h. m. s.	° ′ ″
(6)	(8.9)	19 8 56.74	−41 16 30.06
Brisbane 6501	(6.7)	18 40 25.23	−44 38 19.52

The α of (6) is determined from 8 comparisons with α *Sagittarius* made with the Washington Equatorial; the α of 6501 is from observations with the Washington Meridian-Circle by Professor HUBBARD. The δ of both stars is determined from observations with the Washington Mural-Circle by Professor YARNALL.

ASTRÆA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Stars.	⑤ − *		⑤'s apparent	
				$\Delta\alpha$	$\Delta\delta$	α	δ
1853.	h m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Oct. 3	10 31 34.2	5	B. A. C. 789	+4 9.39	+ 8 51.25	2 31 26.85	+6 58 51.25
4	9 12 43.1	7	" 800	+2 4.89	−11 56.45	2 30 53.20	+6 53 34.51
	*	*	*	*	*	*	*
19	10 9 27.8	4	Weisse II. 312	+0 15.86	− 9 4.53	2 19 36.17	+5 25 7.79

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 789	7	2 27 7.807	+6 48 56.262	B. A. Catalogue, and Rümker.
" 800	7	2 28 38.65	7 4 27.48	B. A. Catalogue, and Santini.
Weisse II. 312	8	2 19 10.75	+5 33 6.67	Weisse's Catalogue.

FLORA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑧ — *		⑧'s apparent	
				Δα	Δδ	α	δ
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
July 23	11 29 37.2	2	Argel. Zones 237, 12	—0 4.94	+ 7 3.18	20 36 21.13	—21 18 0.00
24	10 53 7.6	14	" 237, 12	—1 4.37	— 0 21.30	20 35 21.70	21 25 24.45
28	11 20 13.5	5	" 237, 3	+1 17.04	+ 0 14.73	20 31 7.25	21 55 36.05
30	10 48 1.7	11	" 237, 3	—0 47.84	—14 31.20	20 29 2.40	22 10 22.02
Aug. 6	11 3 5.5	3	" 247, 54	—1 20.39	— 0 13.26	20 21 43.63	22 59 28.63
		3	" 247, 55	—1 36.94	+ 2 33.38	20 21 43.39	22 59 21.88
7	10 18 49.1	3	" 247, 54	—2 19.40	— 6 37.84	20 20 44.62	23 5 53.22
9	10 18 11.2	4	" 240, 97	—0 45.96	+10 29.03	20 18 44.86	23 19 19.17
10	10 10 45.3	6	" 240, 97	—1 44.04	+ 4 16.39	20 17 46.80	23 25 31.81
		6	" 240, 98	—3 14.21	— 5 35.96	20 17 46.57	23 25 36.50
11	10 1 45.1	6	" 240, 97	—2 41.03	— 1 49.70	20 16 49.81	23 31 37.91
12	10 19 2.6	3	" 240, 89	+3 3.90	+18 45.19	20 15 53.11	23 37 26.46
13	10 35 56.6	5	" 240, 89	+2 8.11	+12 51.42	20 14 57.31	—23 43 20.27

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
(¹) Arg. Zones 237, 12	9	20 36 13.34	—21 25 47.98	Argel. Zones, and Washington Mural.
" 237, 3	(8.9)	20 29 37.35	21 56 33.90	Argelander's Zones.
" 247, 54	8	20 22 50.96	22 59 56.50	
" 247, 55	9	20 23 7.27	23 2 36.56	
" 240, 97	8.9	20 19 17.70	23 30 28.20	
" 240, 98	8	20 20 47.64	23 20 41.86	
" 240, 89	7	20 12 36.03	—23 56 49.67	

(¹) The right ascension of this star is reduced in the Bonn observations from the wrong wire (as intimated in a note opposite the observation); but in addition there is an error of 1 minute of time, both in this star and No. 11 of the same Zone, — and an error of 2′ in the declination of No. 12.

CORRIGENDUM.

Pages 119 and 120, in columns for Longitude, *read* h. m. s., *for* ° ′ ″.

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Observations of Thetis, and of the Third and Fourth Comets of 1853, made at the Hamburg Observatory, by Professor C. Rümker.
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On the Deviation of Falling Bodies to the South of a Perpendicular, by Mr. Hubert A. Newton.
Observations of Phocea, Egeria, Astræa, and Flora, made with the Filar-Micrometer of the Washington Equatorial, by Mr. James Ferguson.
Corrigendum.

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NEW FORMULAS OF SPHERICAL TRIGONOMETRY.

By WILLIAM CHAUVENET, A. M.,

PROFESSOR OF ASTRONOMY, ETC. IN THE U. S. NAVAL ACADEMY.

1. From the vertices of the angles A, B, C of any spherical triangle draw arcs of great circles to the pole O of the inscribed circle. Designate these arcs by α, β, γ respectively, and the angles which they make with each other by α_1, β_1, γ_1, so that α_1 denotes the angle made by β, γ; β_1 that by α, γ; γ_1 that by α, β.

From O draw the arc of a great circle OO' to any point O' of the surface of the sphere assumed at pleasure, and denote the angles which this arc makes with α, β, and γ respectively by α_0, β_0, γ_0.

We shall have, (observing that the angles must all be reckoned in the same direction, either from right to left, or from left to right,)

$$\left.\begin{aligned} \sin\alpha_1 &= \sin(\beta_0 - \gamma_0) \\ \sin\beta_1 &= \sin(\gamma_0 - \alpha_0) \\ \sin\gamma_1 &= \sin(\alpha_0 - \beta_0) \end{aligned}\right\} \qquad (1.)$$

Now by the angular analysis we have between any three angles or arcs, as α_0, β_0, γ_0, the following relations:

$$\sin(\beta_0 - \gamma_0)\sin\alpha_0 + \sin(\gamma_0 - \alpha_0)\sin\beta_0 + \sin(\alpha_0 - \beta_0)\sin\gamma_0 = 0 \qquad (2.)$$

$$\sin(\beta_0 - \gamma_0)\cos\alpha_0 + \sin(\gamma_0 - \alpha_0)\cos\beta_0 + \sin(\alpha_0 - \beta_0)\cos\gamma_0 = 0. \qquad (3.)$$

We also have in the spherical triangles of our figure, a, b, and c denoting the sides of $A\,B\,C$,

$$\sin\alpha = \frac{\sin\frac{1}{2}B\sin c}{\sin\gamma_1} = \frac{\sin\frac{1}{2}C\sin b}{\sin\beta_1};$$

or since $\dfrac{\sin c}{\sin b} = \dfrac{\sin C}{\sin B}$,

$$\frac{\sin\frac{1}{2}B\sin C}{\sin\gamma_1} = \frac{\sin\frac{1}{2}C\sin B}{\sin\beta_1},$$

which becomes

$$\frac{\cos\frac{1}{2}C}{\sin\gamma_1} = \frac{\cos\frac{1}{2}B}{\sin\beta_1};$$

whence we infer generally

$$\frac{\cos\frac{1}{2}A}{\sin\alpha_1} = \frac{\cos\frac{1}{2}B}{\sin\beta_1} = \frac{\cos\frac{1}{2}C}{\sin\gamma_1}. \qquad (4.)$$

By means of this relation together with (1) we immediately reduce (2) and (3) to the following:

$$\cos\tfrac{1}{2}A\sin\alpha_0 + \cos\tfrac{1}{2}B\sin\beta_0 + \cos\tfrac{1}{2}C\sin\gamma_0 = 0 \quad \textbf{(I.)}$$

$$\cos\tfrac{1}{2}A\cos\alpha_0 + \cos\tfrac{1}{2}B\cos\beta_0 + \cos\tfrac{1}{2}C\cos\gamma_0 = 0. \quad \textbf{(II.)}$$

2. Again, let α', β', γ' be the perpendiculars from A, B, C, upon a, b, c. We have

$$\sin A\sin\alpha' = \sin B\sin\beta' = \sin C\sin\gamma'$$

$$\sin\tfrac{1}{2}A\sin\alpha = \sin\tfrac{1}{2}B\sin\beta = \sin\tfrac{1}{2}C\sin\gamma,$$

whence

$$\cos\tfrac{1}{2}A\,\frac{\sin\alpha'}{\sin\alpha} = \cos\tfrac{1}{2}B\,\frac{\sin\beta'}{\sin\beta} = \cos\tfrac{1}{2}C\,\frac{\sin\gamma'}{\sin\gamma}, \qquad (5.)$$

which reduce **(I.)** and **(II.)** to

$$\frac{\sin\alpha}{\sin\alpha'}\sin\alpha_0 + \frac{\sin\beta}{\sin\beta'}\sin\beta_0 + \frac{\sin\gamma}{\sin\gamma'}\sin\gamma_0 = 0 \qquad \textbf{(III.)}$$

$$\frac{\sin\alpha}{\sin\alpha'}\cos\alpha_0 + \frac{\sin\beta}{\sin\beta'}\cos\beta_0 + \frac{\sin\gamma}{\sin\gamma'}\cos\gamma_0 = 0. \qquad \textbf{(IV.)}$$

From (4) and (5), we also find,

$$\frac{\sin\alpha_1\sin\alpha'}{\sin\alpha} = \frac{\sin\beta_1\sin\beta'}{\sin\beta} = \frac{\sin\gamma_1\sin\gamma'}{\sin\gamma}. \qquad \textbf{(V.)}$$

I suppose these equations (**I.** – **V.**) to be new, as I have not met with them in trigonometrical works. It is to be presumed, however, that (**V.**), being a very obvious deduction from the figure, has been noticed by others.

ON THE EFFECT OF THE SUN AND MOON UPON THE ROTATORY MOTION OF THE EARTH.

By WILLIAM FERREL.

If a mass, a part of which is fluid, be subjected to the action of foreign forces of the order a, while at the same time it turns upon its axis, Laplace has shown (*Méc. Cel.*, V. i. § 12) that the rotatory motion, neglecting quantities of the order a^2, will be uniform. In doing this he uses the principle of the preservation of areas, which is, that "if we project upon a fixed plane each particle of a system of bodies which react upon each other in any manner whatever, and then draw from the projected positions to a fixed point on that plane lines which we call radii vectores, the sum of the products of each particle by the area described by its radius vector will be proportional to the time t; so that if we put this sum equal to A, we shall have $A = h\,t$, h being a constant quantity." Hence if the element $d\,t$ be taken constant, $d\,A$ will be constant, and $d\,d\,A = 0$. But if the system be subjected to the action of foreign forces, $d\,A$ will be no longer constant, and $d\,d\,A$ will be equal to the sum of all the products of each particle by the area which its radius vector would describe in the time $d\,t$ by means of the foreign forces which act upon it. In showing that the mean rotatory motion of the earth is not affected by means of the foreign forces which act upon it, Laplace neglects the forces of the order a^2, as producing no sensible effect. It is proposed to show in this communication, that, in the case of the earth, there is a small force of the order a^2, arising from the attraction of the sun and moon, which, although extremely small, yet, as its effect increases with the square of the time, must, if not counteracted by some other effect, produce a sensible variation in the earth's rotatory motion.

We shall first consider the effect of the moon; and to render the problem as simple as possible, we will suppose that the earth is a perfect sphere, covered by a fluid of uniform depth, and that the moon moves in the plane of the equator at its mean distance. We shall also take the plane of the equator as the plane of projection, and the center of the earth as the point to which we draw the radii vectores.

Assuming the earth to be a perfect sphere, the effect of the moon is to raise the waters of the ocean on the opposite sides, and to cause the mass to assume the form of a prolate spheroid. If the earth remained a perfect sphere, or if the major axis of this spheroid coincided with the line joining the centers of the earth and moon, the attraction of the moon could not affect the earth's rotatory motion. But in consequence of the resistances which the waters of the ocean suffer in their motions, the major axis of this spheroid forms with the line joining the centers of the earth and moon an angle of about 30°; and the well-known tangential force relatively to the center of gravity, arising from a difference between the attraction of the moon upon the different particles of the earth and the center of gravity, and also from a difference in the direction of this attraction, is not exactly balanced in its action upon the different sides of the mass, in consequence of two opposite parts, in which this force acts in the same direction, being a little more prominent than the other two on account of the spheroidal form which the mass assumes. Hence there is a small residual force of the order a^2, which, acting continually in the same direction, has a tendency to produce a variation in the value of $d\,A$. This force would act upon the waters of the ocean alone, producing a western current, and would not affect the nucleus at all if it did not offer resistance to their motions; but as soon as this resistance becomes equal to the force, the whole force is spent indirectly upon the nucleus; and as, by the principle of the preservation of areas, the action of the particles upon each other cannot change the value of A, the effect is the same as if it acted directly upon the nucleus.

We shall now endeavor to determine the amount of this effect.

Put $1 =$ the semi-axis minor of the spheroid,
$1 + h =$ the semi-axis major,
$1 + h' =$ the distance from the center to the surface of the spheroid,
$r =$ the distance of a particle $d\,m$ from the center,
$\varrho =$ its density, water being unity,
$p =$ the angle between the plane of the moon's meridian and that of $d\,m$,
$q =$ the complement of the latitude of $d\,m$,
$a =$ the angle between the line joining the centers of the earth and moon, and the major axis of the spheroid,
$L =$ the attraction of the moon at the distance of unity,
$\varrho =$ the distance of the centers of the earth and moon,
$l =$ the tangential force acting upon $d\,m$,
$n\,t =$ the angular motion of the earth when not acted upon by a foreign force,
$u =$ the angular motion when acted upon by a foreign force,
$m =$ the mean density of the earth,
$m' =$ the density of the nucleus at the surface.

We shall then have,

$r.\sin q =$ the distance of $d\,m$ from the axis of rotation,

$$d\,m = r^2 \sin q.\, d\,r\;d\,p\;d\,q, \qquad (1.)$$

$$d\,d\,A = -\int \tfrac{1}{2}\, d\,m\,\varrho\,l\,r \sin q.\, d\,t^2, \qquad (2.)$$

$$d\,d\,A = d\,d\,u \int \tfrac{1}{2}\, d\,m\;\varrho\;r^2\;\sin^2 q, \qquad (3.)$$

$$h' = h \sin^2 q \cos^2 (p - a) = h \sin^2 q \, (\cos^2 p \cos^2 a + \sin^2 p \sin^2 a + 2 \sin a \cos a \sin p \cos p). \qquad (4.)$$

To determine l, we must take the attraction of the moon upon $d\,m$, and transfer to $d\,m$ in a contrary direction the force which affects the center of gravity ; and the resultant of these two forces resolved in the direction of the radius, the tangent of the meridian, and the tangent to the motion of $d\,m$, gives for the latter nearly,

$$l = -\frac{3\,L\,r}{\varrho^3} \sin p \cos p \sin q. \qquad (5\,)$$

We know not what is the law of the increase of density toward the center, but we will assume, as an hypothesis being probably not far from the truth, that

$$\varrho = m' + c\,(1 - r^{\frac{3}{2}}), \qquad (6.)$$

c being a constant determinate quantity. This will make the increase of density vary very nearly as the pressure.

In order to determine c, we must take the sum of the products of each particle by its density, divide this sum by the mass, and put the result equal the mean density. Hence we shall have

$$\frac{4\,\pi \int (m'\,r^2 + c\,r^2 - c\,r^{\frac{7}{2}})\,d\,r}{\frac{4}{3}\,\pi\,r^3} = m.$$

Integrating from $r = 0$ to $r = 1$ we obtain $m' + c - \frac{2}{3}\,c = m$, whence $c = 3\,(m - m')$. Substituting this in equation (6) we obtain

$$\varrho = 3\,m - 2\,m' - 3\,(m - m')\,r^{\frac{3}{2}}. \qquad (7.)$$

From equations (2) and (3) we deduce

$$-d\,d\,u = d\,t^2 \frac{\int d\,m\,\varrho\,l\,r \sin q}{\int d\,m\,\varrho\,r^2 \sin^2 q};$$

and by integrating,

$$n\,d\,t - d\,u = t\,d\,t \frac{\int d\,m\,\varrho\,l\,r \sin q}{\int d\,m\,\varrho\,r^2 \sin^2 q};$$

$n\,d\,t$ being the value of $d\,u$ when $t = 0$. Integrating again we obtain,

$$n\,t - u = \tfrac{1}{2}\,t^2 \frac{\int d\,m\,\varrho\,l\,r \sin q}{\int d\,m\,\varrho\,r^2 \sin^2 q} = \tfrac{1}{2}\,t^2 \frac{M}{N}, \qquad (8.)$$

putting

$$M = -\int d\,m\,\varrho\,l\,r \sin q, \qquad (9.)$$

and

$$N = \int d\,m\,\varrho\,r^2 \sin^2 q. \qquad (10.)$$

If, in equation (9), we put for $d\,m$ and l their values found in (1) and (6), we shall obtain

$$M = \frac{3\,L}{\varrho^3} \iiint r^4\,d\,r\,d\,p\,d\,q \sin p \cos p \sin^3 q. \qquad (11.)$$

This integral must be taken from $r = 1$ to $r = 1 + h'$, and from $p = 0$ to $p = 2\,\pi$, and from $q = 0$ to $q = \pi$, so as to embrace the part only by which the spheroid differs from the inscribed sphere. Hence ϱ must be taken equal unity. We shall therefore have $\int r^4\,d\,r = h'$, neglecting higher powers of h'. Substituting the value of h' in equation (4), instead of $\int r^4\,d\,r$ in (11), we obtain,

$$M = \frac{3\,L\,h}{\varrho^3} \Big(\iint d\,p\,d\,q \cos^2 a \cos^2 p \sin p \cos p \sin^5 q + \iint d\,p\,d\,q \sin^2 a \sin^2 p \sin p \cos p \sin^5 q$$
$$+ 2 \iint d\,p\,d\,q \sin a \cos a \sin^2 p \cos^2 p \sin^5 q \Big). \qquad (12.)$$

The first two terms give nothing by integration. The last is equal to

$$\frac{3\,L\,h}{\varrho^3} \sin 2\,a \iint d\,p\,d\,q \sin^2 p \cos^2 p \sin^5 q.$$

But

$$\int d\,p \sin^2 p \cos^2 p = \int \sin^2 p\,(1 - \sin^2 p)^{\frac{1}{2}}\,d \sin p,$$

and integrating from $p = 0$ to $p = 2\,\pi$,

$$\int \sin^2 p\,(1 - \sin^2 p)^{\frac{1}{2}}\,d \sin p = \tfrac{1}{4}\,\pi. \qquad (13.)$$

We shall also have

$$\int \sin^5 q\,d\,q = \int (1 - \cos^2 q)^2\,d \cos q$$
$$= \int (1 - 2\cos^2 q + \cos^4 q)\,d \cos q$$
$$= 2\,(1 - \tfrac{2}{3} + \tfrac{1}{5}) = \tfrac{16}{15},$$

integrating from $q = 0$ to $q = \pi$. Hence we shall have

$$M = \frac{3\,L\,h}{\varrho^3} \sin 2\,a \times \tfrac{1}{4}\,\pi \times \tfrac{16}{15} = \frac{4\,L\,h}{5\,\varrho^3} \sin 2\,a\,.\,\pi. \qquad (14.)$$

If in (10) we substitute the values of $d\,m$ and ϱ found in (1) and (6) we shall find

$$N = \iiint (3\,m - 2\,m' - 3\,(m - m')\,r)\,r^4\,d\,r\,d\,p\,d\,q \sin^3 q. \qquad (15.)$$

But $\int (3\,m - 2\,m' - 3\,(m - m')\,r^{\frac{3}{2}})\,r^4\,d\,r = \frac{9\,m + 4\,m'}{65}$,

$\int d\,p = 2\,\pi$, and $\int d\,q \sin^3 q = \int (1 - \cos^2 q)\,d \cos q$

$= 2\,(1 - \frac{1}{3}) = \frac{4}{3}$.

Substituting these values in (15), we get

$$N = \frac{72\,m + 32\,m'}{195}\,\pi. \qquad (16.)$$

Hence, from (8), (14), and (16), we obtain

$$n\,t - u = \frac{39\,L\,.\,h\,.\sin 2\,a}{\varrho^3\,(36\,m + 16\,m')}\,.\,t^2 \qquad (17.)$$

Now the attraction of the earth at the distance of the equatorial radius, is 32.148 feet ; and putting the attraction of the moon $\frac{1}{75}$ of that of the earth, we shall have

$$L = \frac{32.148}{75 \times 20922000}$$

in terms of the earth's radius. Assuming that the tide caused by the action of the moon in the open sea is two feet, and that it happens two hours after the moon passes the meridian, we shall have $h = 2$, and the angle $a = 30$, and consequently $\sin 2a = .66602$. We will also put $\varrho = 60$, $m = 5\frac{1}{2}$, and $m' = 2\frac{3}{4}$, and $t = 100$ years $= 3155760000$ seconds. These values will give $n\,t - u = 50.07$ miles for the amount the earth would be retarded at the equator in a century, upon the hypothesis that the whole nucleus is covered with water. But as the waters of the ocean do not completely assume the spheroidal form on account of the continents, which occupy about one fourth of the surface, we must deduct one fourth from the value of $n\,t - u$, and we shall then have for the effect of the moon in one century

$$n\,t - u = 37.44 \text{ miles.} \qquad (18.)$$

Now if, in equation (17), L be increased or diminished, h will be increased or diminished in the same ratio; hence the effect of any other body in changing the value of $n\,t - u$ will be as the square of its effect in causing tides. But this effect of the sun is $\frac{3}{7}$ of that of the moon, and consequently its effect upon the value of $n\,t - u$ will be $\frac{9}{49}$ of that of the moon. We shall therefore have for the effect of both sun and moon,

$$n\,t - u = 44.45 \text{ miles.} \qquad (19.)$$

If the motion of the earth were retarded by this amount, it would cause an apparent acceleration of the heavenly bodies in their orbits, which in the case of the moon would amount to 84″ in a century. And as no such acceleration has been observed above what is accounted for otherwise, the rotatory motion of the earth must be nearly uniform, and the above effect of the sun and moon must be counteracted by the gradual contraction of the earth through a loss of temperature.

We shall now determine at what rate the earth's radius must contract, supposing it to contract equally throughout its whole mass, in order that the angular motion gained by contraction may balance that lost by the action of the sun and moon upon the tides.

Put $1 =$ the radius of the earth at the beginning of the time t,
$r' =$ the radius of the earth at the end of the time t,
$n =$ the velocity of the angular motion at the beginning of t,
$n' =$ the velocity at any time t,
$s =$ the angular motion of the earth in a state of contraction, and not affected by the action of the sun and moon.

In order that the two effects may counteract each other, we must have

$$d\,d\,s + d\,d\,u = 0 \qquad (20.)$$

We will also have

$$d\,s = n'\,d\,t \qquad (21.)$$

$$d\,A = d\,s \int \tfrac{1}{2}\, d\,m \,.\, \varrho \,.\, r^2 \,.\, \sin^2 q. \qquad (22.)$$

Now if we suppose the earth to contract equally throughout its whole mass, it is evident $d\,m \,.\, \varrho$ will be constant, and also $\sin^2 q$, considering r only as the variable. And by the principle of the preservation of areas, $d\,A$ cannot be affected by the earth's contraction; and hence $d\,s \,.\, r^2$ must be constant, and consequently, since r^2 varies as r'^2, $d\,s\,r'^2$ must be constant. And hence we shall have

$$r'^2\, d\,d\,s + 2\,r'\,d\,r'\,d\,s = 0 \qquad (23.)$$

If in (17) we put the coefficient of t^2 equal c, and differentiate twice, we shall get

$$-d\,d\,u = 2\,c\,d\,t^2. \qquad (24.)$$

From (20), (21), (23), and (24), we obtain $-d\,r' = \frac{c\,r'}{n'}\,d\,t$. But as r' and n' in the last member vary very little respectively from 1 and r, the latter may be substituted in their place; and hence we obtain by integration $1 - r' = \frac{c}{n} \,.\, t$; and from this and (17),

$$1 - r' = \frac{n\,t - u}{n\,t}. \qquad (25.)$$

Now n, being the velocity of the earth at the equator, is equal to 1630 feet; also $n\,t - u = 44.45$ miles, and $t = 3{,}155{,}760{,}000$ seconds. These values give $1 - r' = 1.017$ feet for the contraction of the earth's radius in a century, upon the hypothesis that it contracts equally throughout its mass.

It has been supposed to have been demonstrated, that from the time of Hipparchus, about two thousand years ago, until the present time, there has been no sensible diminution of the earth's radius, and consequently of its temperature; since, if there had been, there would have been a sensible diminution in the moon's secular equation on account of an increase in the amount of the earth's rotatory motion. But if the above effect of the sun and moon upon the tides be admitted, the radius of the earth must have contracted more than one foot per century to counteract this effect, and to maintain the uniformity of its rotatory motion. And this is exactly in accordance with what, from other considerations, we have reason to suppose is taking place. The surface of the earth has doubtless long since cooled down to that temperature at which the amount of heat received from the sun equals the quantity radiated, and consequently it has ceased to contract; but if, as we know from observations made in mines, and upon the waters of Artesian wells, the temperature increases about 1° of Fahrenheit for every 45 feet in depth, the interior of the earth, at a very short distance from the surface, must be much hotter than the surface; and therefore the cooling and consequent contraction of the earth must be still going on, and will continue to do so until an equilibrium is produced between the interior and the surface. And if, as we have reason to believe, mountain ranges, continents, and all the unevenness of the earth's surface, have been caused by the cooling of the interior after the surface had ceased, may not the same be going on still, though perhaps at a much less rapid rate, and thus produce the gradual changes of level which are continually taking place in the earth's crust? For if the interior contract while the crust does not, it must become too large, and consequently some parts will sink down, and others have a tendency to rise up.

As we do not know how much the materials of the earth expand or contract for a given change of temperature, we cannot tell exactly at what rate it must cool, supposing it to cool equally throughout its whole mass, to produce the above amount of contraction; but upon the most probable hypothesis, judging from the expansibility of the materials of its surface, it must have lost less than 1° of Fahrenheit since the creation of man.

Another very important consideration in connection with this subject is, that upon the above principle, that a mass, either wholly or in part fluid, is retarded in its rotatory motion by the attraction of a foreign body, we may account for the remarkable, and hitherto unaccountable phenomenon, that the moon and all the other satellites perform a revolution upon their axes in exactly the same time in which they revolve in their orbits around their primaries. This is a phenomenon which we cannot philosophically suppose to be the result either of chance or design; and consequently it must have some physical cause. If we suppose that the satellites were once, for a long period of time, either wholly or in part fluid, it is evident that the attraction of the sun and their primaries would have an effect upon them similar to the effect of the sun and moon upon the earth, except that it would be many times greater. For we have seen that the effect of any disturbing body in retarding the rotatory motion of another, is as the square of its attraction. Hence the effect of the earth upon the moon would be about 562.5 times greater than the effect of the moon upon the earth. Now the effect of the primaries upon the satellites being so much greater, a very small part of it would be counteracted by contraction through loss of temperature. Hence, whatever may have been the original velocity of the rotatory motion of the satellites, the effect of the sun and their primaries, continually acting during an indefinitely long period of time, may have reduced the time of their revolution around their axes, so as to correspond exactly with the time of their revolution around their primaries. It is true this would require a very long period of time, but it would only furnish an additional proof from Astronomy, to the many we already have in Geology, of the great age of the universe.

Allensville, Ky., 1853, *September* 24.

FROM A LETTER FROM DR. C. H. F. PETERS TO THE EDITOR.

Constantinople, 1853, *September* 19.

The greater part of my time during the last year has been employed in an investigation concerning the next appearance of the comet of thirteen years' period. It appeared to have approached since its last perihelion passage so near to *Saturn*, that, with the uncertainty which unavoidably remains in the elements deduced from the appearance in 1846, even a total change in the orbit appeared possible. In the beginning I expected to succeed by assuming all the elements of the form $\pi + \Delta\pi$, $\Omega + \Delta\Omega$, &c., and retaining the indeterminate quantities $\Delta\pi$, $\Delta\Omega$, &c. through the whole integration of the perturbations. By this means I obtained elements for 1859 of the form $\pi + a\,\Delta\pi + b\,\Delta\Omega + c\,\Delta\phi + e\,\Delta i + f\,\Delta L + g\,\Delta\mu$, in which I could then substitute, instead of these indeterminates, quantities proportional to the probable errors found in 1846; — though of course applying Encke's theorem (*Berl. Jahrb.* 1835, p. 302). From this I attained the conviction that *Saturn* was not to carry off the comet at this revolution, on account of the fortunate difference in the latitude of the two bodies, — and that the perturbations in 1855 were not to be as great as I had feared.

Still, the results of this tedious and protracted computation did not prove satisfactory enough, inasmuch as this method can only be well adapted for the purpose in cases where the period of revolution is known with greater precision, relatively to the other elements. I therefore next computed the *Saturn*-perturbations for five different values of the original μ (mean motion) contained within the probable limits of error. Each of these hypotheses affords, for any given day of the years 1858–1860, a different apparent place of the comet, and these places when connected together marked out a line upon the celestial sphere, in which the comet is to be looked for.

Of course only those parts of these lines need be known in which the comet will be when near its perihelion, — that is to say, while visible; and I have taken 48 days before and after the perihelion. The probable errors of the remaining elements, excepting $M_0 = L_0 - \pi_0$ give a breadth to these lines, and I am at present occupied in examining this effect. I believe that, by furnishing to observers a narrow stripe in which the comet is to be looked for, rather than a point, I shall give them the simplest and most easy means of finding the comet, a matter which appears to me of great interest. The only circumstances under which it could fail to be visible during those years would be, if it should come to perihelion just as the perihelion is in conjunction with the sun; but the probabilities are strongly against this.

C. H. F. PETERS.

OBSERVATIONS OF PLANETS AT THE OBSERVATORY IN HAMBURG.

By PROFESSOR CHARLES RÜMKER.

THETIS.

1853.	Hamburg M. T.	⑰ α	Log. Fact. Parall.	⑰ δ	Log. Fact. Parall.	No. of Comp.	Comp.-Star.
	h. m. s.	° ′ ″		° ′ ″			
Aug. 11	11 55 9.2	355 24 45.0	9.5499*n*	—7 28 41.4	9.9345	11	$\alpha\ \beta\ \gamma$
12	12 3 53.3	355 17 57.9	9.5480*n*				$\beta\ \gamma$
25	10 25 50.4	353 20 48.4	9.6136*n*	9 9 31.8	9.9355	11	*v*
27	9 53 28.5	352 58 32.9	9.6568*n*	9 24 44.0	9.9326	8	*u*
28	9 57 21.0	352 47 0.3	9.6420*n*	9 32 50.0	9.9342	11	*s*
Sept. 3	10 56 5.1	351 33 4.7	9.4002*n*	10 20 8.1	9.9478	2	*p*
4	10 3 52.2	351 20 39.7	9.5572*n*	10 27 46.4	9.9426	12	*q*
5	10 34 8.0	351 7 37.1	9.4488*n*	10 35 30.0	9.9473	12	*q*
8	9 57 38.0	350 29 9.3	9.5225*n*	10 57 57.1	9.9458	10	*m*, *o*
9	9 59 12.2	350 16 6.4	9.5037*n*	11 5 36.2	9.9470	12	*m*
11	10 30 30.5	349 49 50.5	9.3457*n*	11 20 2.2	9.9520	14	*n*
12	10 28 4.1	349 37 9.7	9.3825*n*	11 27 25.0	9.9485	6	*l*
27	8 23 0.4	346 39 3.2	9.5388*n*	12 51 48.8	9.9505	11	*e*
30	10 49 11.4	346 8 5.4	8.7839	13 7 56.8	9.9627	16	*f*, *g*
Oct. 1	12 1 24.6	345 58 12.0	9.4111	13 11 41.5	9.9572	7	*f*, *g*
3	9 8 1.8	345 41 51.3	9.2329*n*	13 18 38.6	9.9604	11	*f*
4	10 17 12.8	345 33 4.2	8.3776	—13 21 52.4	9.9632	13	*d*

Mean Places for 1853.0 *of Stars in the Geocentric Orbit of Thetis, from Observations with the Meridian-Circle.*

Name.	Mag.	✱ α	✱ δ	No. Obs.	Name.	Mag.	✱ α	✱ δ	No. Obs.
		h. m. s.	° ′ ″				h. m. s	° ′ ″	
a	10	22 51 51.079	—13 21 25.1	1	*p*	9	23 25 34.145	—10 16 37.2	1
b	10	22 58 42.812	13 46 26.1	1	*q*	8	23 26 42.872	10 31 18.0	2
c	8	22 59 15.995	13 31 13.4	2	*r*	8	23 27 39.930	10 30 1.5	2
d	9	23 1 44.631	13 24 51.5	2	*s*	7	23 28 25.073	9 34 39.4	2
e	dup.	23 4 18.375	12 43 49.5	1	*t*	8	23 30 6.372	10 47 15.6	2
f	9	23 5 7.467	13 23 42.0	2	*u*	7	23 30 36.902	9 26 24.4	1
g	9	23 5 27.839	13 27 51.9	2	*v*	9	23 33 48.338	9 26 38.1	1
h	9	23 10 12.220	12 4 0.4	1	*w*	8.9	23 34 1.743	9 38 13.4	3
i	9	23 12 47.939	11 37 20.7	2	*x*	8.9	23 34 48.479	9 38 26.7	1
k	8	23 13 13.506	11 20 10.0	2	*y*	9	23 37 4.462	14 57 6.0	1
l	9	23 18 41.375	11 29 25.2	5	*z*	9	23 38 19.752	6 44 58.4	1
m	9	23 21 14.933	10 54 34.9	2	α	7	23 40 59.095	7 14 46.9	3
n	9	23 22 37.542	11 15 29.0	2	β	9	23 44 13.053	7 25 46.2	3
o	9	23 23 14.564	—10 57 58.4	1	γ	9	23 44 17.532	—7 25 45.2	2

METIS.

1853.	Hamburg M. T.	⑨ α	Log. Fact. Parall.	⑨ δ	Log. Fact. Parall.	No of Comp.	Apparent Place of Comparison-Stars.	
							α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
Oct. 8	9 20 31.6	17 39 11.4	9.5851*n*	—1 20 5.8	9.9100	8	1 12 19.946	—1 16 37.7
18	7 28 37.5	15 15 1.2	9.6942*n*	1 53 47.0	9.9102	4	0 58 56.605 0 59 19.229	1 31 48.7 1 43 21.8
23	7 45 35.0	14 6 13.0	9.6299*n*	2 5 4.3	9.9124	1	0 55 58.184	2 16 53.4
24	7 17 36.2	13 53 17.9	9.6689*n*	2 6 49.5	9.9116	7	0 52 7.217	2 7 0.1
24	10 42 34.5	13 51 24.8		2 7 2.2	9.9160		Merid.-Circle.	
25	6 39 21.6	13 40 56.8	9.7126*n*	2 8 13.5	9.9102	3	0 52 7.218	—2 7 0.0
25	10 37 47.8	13 38 40.9		2 8 30.6	9.9161		Merid.-Circle.	
26	10 33 2.1	13 26 9.4		2 9 46.7	9.9163		" "	
27	10 28 17.5	13 13 56.4		—2 10 54.6	9.9163		" "	

THIRD COMET OF 1853.

FROM A LETTER OF DR. MÖSTA TO LIEUTENANT GILLISS.

Santiago de Chile, 1853, *September* 29.

A FINE comet was seen on the morning of the 16th instant, in R.A. 10h. 15m., and South Dec. 23° 4′. It is visible to the naked eye, its nucleus being very well defined, and as brilliant as a star of the 6.7 magnitude. Its tail is so faint that it is scarcely possible to determine its length.

I observed it on the 16th, 17th, 23d, 24th, 27th, and 28th instant; — its position at the last observation being R.A. 9h. 55m., Dec. —30° 50′. On the 27th, the comparison-star was Lacaille 4072; on the 28th, Lacaille 4098; but none of the stars used on preceding days are to be found in the catalogues. I must therefore wait to determine their positions before sending you my observations.

It will be interesting to you to know that on the 26th instant it snowed at Santiago for about half an hour, and for a few minutes even Cerro San Cristoval was covered.

C. W. MÖSTA.

OBSERVATIONS OF THETIS AND METIS,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury.]

[Corrected for refraction.]

THETIS.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑰ — * Δα	⑰ — * Δδ	⑰'s apparent α	⑰'s apparent δ
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Sept. 8	9 5 16.9	6	Weisse XXIII. 377	+2 41.34	— 9 20.96	23 21 45.61	—10 59 37.72
	9 9 16.9	5	" 423	+0 27.73	— 5 18.93	21 45.35	10 59 42.14
		5	" 463	—1 31.70	— 1 57.21	21 45.37	10 59 38.83
10	9 33 14.8	12	" 423	—1 16.72	—20 3.28	20 0.92	11 14 26.21
11	9 2 17.5	6	" 309	+3 45.44	+13 11.15	19 9.03	11 21 32.24
13	8 44 51.6	12	" 309	+2 2.69	— 0 45.02	17 26.29	11 35 28.45
15	9 38 30.9	10	" 309	+0 18.73	—14 27.96	15 42.35	11 49 11.41
23	8 53 20.1	16	" 185	—0 43.56	— 5 48.18	9 18.65	12 36 28.87
24	8 19 27.4	10	" 185	—1 27.32	—10 52.82	8 34.50	12 41 33.47
25	8 20 28.5	6	" 185	—2 12.25	—15 50.18	7 49.96	12 46 30.79
29	9 22 33.9	6	" 14	+2 58.32	—10 23.79	5 4.23	13 3 14.06
Oct. 3	11 12 35.2	6	" 9	+0 48.73	+ 5 4.84	2 36.28	13 19 37.66
4	8 7 58.1	16	" 9	+0 20.05	+ 2 21.45	2 7.59	13 22 20.99
Nov. 14	6 37 16.5	2	" 12	—0 22.95	+ 8 55.99	1 36.62	12 41 15.23
	6 43 44.5	5	" 14	—0 29.22	+11 26.33	1 36.25	12 41 18.41
25	7 15 30.7	6	" 143	+0 7.30	+ 5 53.55	8 15.88	11 44 29.29
	7 53 32.1	4	" 143	+0 8.71	+ 6 2.47	8 17.29	11 44 20.37
26	7 40 40.4	12	" 143	+0 51.46	+11 50.26	23 9 0.06	—11 38 32.35

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XXIII. 377	8.9	23 18 49.17	—10 51 30.13	Weisse's Catalogue.
" 423	9	21 5.85	10 55 37.05	
" 463	9	23 5.34	10 58 55.72	
" 309	8	15 11.74	11 35 56.99	
" 185	7	9 50.28	12 31 53.18	
" 14	9	1 53.95	12 54 1.85	
" 9	9	1 35.58	13 25 53.86	
" 12	9	1 48.00	12 51 27.74	
" 143	8	23 7 57.13	—11 51 39.30	

METIS.

Date	M. T. Washington.	No. of Comp.	Comparison-Star.	⑨ — *		⑨'s apparent	
				$\Delta\alpha$	$\Delta\delta$	α	δ
1854.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Sept. 23	9 45 0.6	12	Weisse I. 375	+1 20.25	+ 7 41.79	1 23 44.08	—0 15 13.69
24	9 3 38.6	14	" "	+0 35.22	+ 3 21.11	1 22 59.05	0 19 34.35
25	8 57 42.7	20	" "	—0 12.14	— 1 9.17	1 22 11.70	0 24 4.59
26	9 31 28.7	10	" "	—1 2.25	— 5 50.84	1 21 21.01	0 28 46.22
Oct. 6	9 52 15.6	11	B. A. C. 400	—0 1.88	+ 3 41.41	1 12 18.20	1 12 55.98
7	8 57 12.2	16	" "	—0 57.55	— 0 18.72	1 11 22.54	1 16 56.10
11	9 5 19.2	4	Weisse I. 104	+0 6.51	+12 54.74	1 7 28.12	1 32 34.27
13	8 39 4.1	5	" "	—1 49.31	+ 6 1.61	1 5 32.02	1 39 27.24
15	9 55 3.4	12	Lamont 3059	+0 3.81	+ 0 12.76	1 3 32.85	1 46 4.59
17	9 48 25.2	3	" "	—1 51.06	— 5 40.85	1 1 37.99	1 51 58.22
		3	Weisse I. 104	—5 43.85	— 6 32.70	1 1 37.80	1 52 1.70
31	9 10 29.5	6	Weisse O. 908	—2 22.64	— 6 15.72	0 49 44.59	2 13 16.24
Nov. 1	9 24 36.5	6	" 815	+1 17.05	+ 4 32.25	0 49 2.38	2 13 17.60
2	8 46 25.8	11	" 815	+0 37.78	+ 4 45.14	0 48 23.31	2 13 4.70
14	7 29 33.0	8	" 687	+2 51.49	+ 3 27.87	0 42 35.01	1 51 52.53
25	8 20 42.7	6	" 732	—1 15.79	— 8 32.61	0 41 10.09	1 9 49.14
26	8 30 47.2	6	" 732	—1 11.72	— 3 21.01	0 41 14.15	—1 4 37.65

Adopted Mean Places, 1850.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse I. 375	8.9	1 22 12.22	—0 24 8.51	Weisse's Catalogue.
B. A. C. 400	6	1 12 8.35	1 17 51.54	B. A. Catalogue ; A. S. Cat. ; Weisse's Cat.
Weisse I. 104	6.7	1 7 9.85	1 46 43.44	A. S. Catalogue ; Weisse's Catalogue.
(1) Lamont 3059	9.10	1 3 17.26	1 47 31.99	Lamont's Zones.
Weisse O. 908	9	0 51 55.43	2 8 15.22	Weisse's Catalogue.
(2) " 815	9	0 47 33.75	2 19 4.71	Weisse's Catalogue, and Lalande's Catalogue.
" 687	9	0 39 31.81	1 58 34.71	Weisse's Catalogue.
" 732	7	0 42 14.19	—1 2 30.45	Weisse's Catalogue, and Lamont's Zones. 2699, 2984, 3391, 3520.

(1) Declination of this star 1′ erroneous in LAMONT.

(2) Right-ascension of this star 1 minute (of time) erroneous in WEISSE.

NEW COMET.

MR. ROBERT VAN ARSDALE has communicated the following approximate places of a comet discovered by him on the 25th of November, at Newark, N. J.

November 25, at $6^{h.}$ $50^{m.}$ P. M., R.A. $2^{h.}$ $7^{m.}$, Dec. +60° 12′.

November 30, at Meridian Passage $9^{h.}$ $5^{m.}$, R.A. $1^{h.}$ $44^{m.}$, Dec. +54° 10′.

TWENTY-SEVENTH ASTEROID.

In a letter to the *London Times*, Mr. HIND informs the public that he detected another asteroid (㉗) on the evening of Tuesday, November 8, in *Taurus*, about 2° South Latitude.

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THE TOTAL ECLIPSE OF THE SUN OF NOVEMBER 30, 1853.

LETTER FROM DR. MÖSTA, DIRECTOR OF THE OBSERVATORY AT SANTIAGO DE CHILE, TO LIEUTENANT GILLISS.

Lima, 1853, *December* 11.

I HAVE just arrived here from my journey to the south of Pisco, where the total eclipse of the sun was observed on the 30th ultimo, and take advantage of the earliest moment to communicate briefly the phenomena I had the fortune to witness. Having furnished myself with the small Equatorial of the Observatory (5-feet Frauenhofer), a $3\frac{1}{2}$-feet Dolland, a reflecting circle and chronometer, I left Santiago, with my assistant, Mr. LIRA, on the 24th of October, and arrived at Pisco, by the steamer, November 9. At the latter place a few observations were made, and we started for Ica, a small town fourteen leagues distant, the determination of whose latitude showed me it was necessary to proceed still farther south. Pisco and Ica are situated on a sandy plain, with intervening hills of the same character, on which there is never any rain. These extend as far as the first spurs of the Cordilleras, some fourteen leagues distant from the ocean, and greatly resemble topographically the vicinity of Caldéra (Chile). As the rainy season had already commenced on the Cordilleras (it usually rains from November to April), I determined to make a station on the plain, and proceeded south as far as latitude 14° 21′ S., approximate longitude 75° 39′ W. Here there were a few ranchos belonging to the Hacienda de Oonoaje, an estate occupying a valley of the sandy plain, surrounded on all sides by barren hills. Though the central line of the eclipse on this meridian was calculated at two miles farther to the southward, I preferred remaining near the ranchos just mentioned.

The 5-feet telescope was placed to the north of a large fig-tree so as to shelter it from the south wind, yet so as to preserve a full view to the north and west and a partial view of the south and east horizon. Quite a fresh wind commenced about two hours before the beginning of the eclipse. Mr. LIRA's telescope was placed on the opposite side of the tree. A countryman of yours, Mr. R. CLARK, — whose acquaintance I made at Santiago some time since, and subsequently met in Ica, — kindly undertook observations on the phenomena exhibited by plants and animals, direction of the wind, &c.

I gave particular attention to the phenomenon observed by Mr. SCHMIDT on former occasions, and have the satisfaction to write you the following corroboratory facts. Several days before the eclipse I examined the solar disc carefully for spots and faculæ, and on the 13th, whilst at Pisco, two small spots were noted, which remained visible for several days thereafter. On the 29th and 30th of November, neither spot nor faculæ were perceptible; the disc was of uniform brightness.

The first contact of the limbs occurred without exhibiting protuberances between them, and the moon proceeded in its path across the sun's disc without presenting any notable phenomenon. The moon's southern limb was very uneven, but no particular elevation was remarked. Twelve or fifteen minutes before the beginning of the total eclipse, the space between the moon's limb and the bright limb of the sun was instantaneously covered by a dark rosy nebulous matter, and I am sure there was no kind of connection between them prior to the apparition of this matter. As the unobserved portion of the sun became smaller, this nebula became of a darker color, as though compressed, and finally it became difficult to distinguish the limbs with satisfaction. As soon as the second contact took place, the cloud disappeared, leaving no trace behind. But from this instant the eclipse presented an aspect more glorious than I can describe. The moon was surrounded by a luminous corona of uniformly white light, just as you have seen on clear evenings at Santiago, when the full moon chanced to be concentrically covered by a smaller and dark body which, for the instant, caused an annular eclipse. As this light gradually diminished in intensity, and at the same time became yellowish or orange-colored, it was impossible to determine the dimensions of the corona. If we suppose a vertical circle passing through the sun's center, then the semi-circumference of the corona north of the vertical was a perfectly uniform half-annulus, whilst the opposite half formed two broad and conical beams of white light very similar to the tails of comets. The length of the superior beam was, at least, equal to the diameter of the sun ; the lower one was of smaller dimensions. It was remarked that they were not opposite to each other, the first having an inclination from the vertical of about 30°, and the second, on the northern side, an inclination of only 20°. The remaining portion of this latter half of the corona was occupied by many smaller rays or beams of similar form. Immediately after the commencement of the total eclipse, a rose-colored cloud was observed near the lower large beam of light, apparently moving towards the lower great cone. Its greatest height above the edge of the moon, as measured by the wire-micrometer, was 1′ 8″: its rosy color became orange, afterward yellowish, and the cloud or eminence disappeared, after remaining visible nearly 1m. 20s.. Above this, there were two black spots close to the moon's edge, which were even visible to the naked eye, every one present remarking them. Their forms were nearly square, each side of which I estimated at 1′. As I looked at them with the telescope twice, I cannot think it an optical illusion. What may have been their cause ?

A drawing was prepared immediately after the eclipse, a copy of which is inclosed for you. At the third contact of the limbs, I could not detect any protuberance similar to that witnessed at the beginning of the total eclipse, nor was any such phenomenon seen at the last contact.

The duration of the total observation was 2m. 59s..5 sidereal time. Darkness was not as great as we had anticipated, as we were able to read the first page of the Nautical Almanac at a distance of three feet, and the Assistant could readily distinguish the scale of a TROUGHTON and SIMMS standard thermometer all the time. *Jupiter* and *α Scorpii* became visible, and *Venus* continued so for 24m. after the greatest obscuration. Many interesting observations concerning animals, plants, color, and temperature of the atmosphere, were recorded, but the hour for delivering this letter at the post-office is fast approaching, and I must omit writing you more at length until I shall have made the reductions and sent in my report to the government on my return to Santiago. But I must not omit to mention, that the astronomical commission has been received in the most flattering manner by the Peruvian government, and the *Cosmografo-mayor* of Lima was instructed to associate himself with us on the expedition. . . . . .

C. W. MÖSTA.

OBSERVATIONS OF EUTERPE,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

BY MR. JAMES FERGUSON.

[Communicated by Lieutenant MAURY.]

[Corrected for refraction.]

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉗ — *		㉗'s apparent	
				Δα	Δδ	α	δ
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Dec. 13	7 11 16.7	3	Weisse II. 881	+0 18.55	+16 37.06	2 50 53.53	+14 50 40.59
	8 28 2.2	5	" "	+0 17.10	+16 35.42	50 52.08	50 39.01
	10 12 29.7	3	" "	+0 15.78	+16 34.83	50 50.76	50 38.35
14	6 3 37.7	22	" "	—0 0.33	+16 49.02	50 34.65	50 51.73
15	6 17 36.4	14	" "	—0 18.08	+16 56.07	2 50 16.89	+14 50 59.86

Adopted Mean Place, 1850.0, *of Comparison-Star.*

*	α	δ
	h. m. s.	° ′ ″
Weisse II. 881	2 50 21.97	+14 33 3.85

The magnitude of the asteroid estimated at (9.2).

COMET I. 1854.

PROFESSOR STEPHEN ALEXANDER has obtained the following elements of this comet from the following observations of Mr. VAN ARSDALE at Newark, N. J.

		☄ α	☄ δ
	h. m.	h. m.	° ′
Nov. 25	6 50	2 7	60 12
Dec. 9	8 6	1 21 30s.	43 2
22	7 0	1 6	28 30

T	1854, Jan. $9^{d}.02060$ M. T. Greenwich.	
π	$53^{\circ}\ 16'\ 54''$	Mean Equinox of Jan. 1.
☊	226 24 45	
i	64 46 12	
Log q	0.3080548	
q	2.032614	
Motion Retrograde.		

These elements represent the middle place in longitude and latitude as follows: —

$$\overset{\text{Calc. — Obs.}}{\delta\lambda = -8'\ 11'' \qquad \delta\beta = +4'\ 23''}$$

All the corrections were applied to the observed places.

Professor **Alexander** remarks that the perihelion distance is the greatest on record, with four exceptions, and that in the three elements of retrograde motion, node, and inclination, it resembles Comet IV. 1853; that they might then appear to have been related to one another as are the two portions of Biela's Comet, but that the great perihelion distance of Comet I. 1854 would seem to forbid such a supposition.

This comet has been observed at Göttingen by **Klinkerfues**. His first observation was on December 2, a week after its discovery by Mr. **Van Arsdale**.

ELEMENTS AND EPHEMERIS OF MELPOMENE.

By ERNEST SCHUBERT.

[From a Report to Lieutenant **Charles Henry Davis**, Superintendent Nautical Almanac.]

For my first work on *Melpomene* ⑱, you had charged me with an entirely independent computation of elements from three normal places; and with the computation of an ephemeris from the obtained new elements for the period of observations beginning in 1853.

Melpomene has been observed, in the first period of observations, from 1852, June 24, to 1853, January 17. I found that there were observations enough for the formation of normal places for the beginning and the end of this period; and also for the middle of it, about October 1. It would have been sufficient to compute, from a first approximation of the elements by Messrs. **Schönfeld** and **Thormann** in Bonn (*Astronomical Journal*, No. 48), only three short ephemerides, and to compare with them the observations made about 1852, July 1, Oct. 1, and 1853, Jan. 1. But since it is necessary that, at a later time, for the correction of the elements by the method of least squares, all good observations be discussed and more normal places be formed, I resolved to compute, at once, an ephemeris for the whole first period of observation, from the elements mentioned above. It is evidently quite indifferent, for the mere purpose of forming normal places, how near the approximation of an ephemeris is, if only one and the same principle is adhered to.

I have some critical remarks on some of the observations used in the formation of the normal places.

Kremsmünster, 1852, July 4. — The seconds of observed Declination are probably erroneous by 10, and I took 38″.7 instead of 28″.7.

In the Washington observations (*Astronomical Journal*, No. 50, page 11) there are the following probable mistakes: — 1852, Sept. 13, the minutes of Dec. are 47 instead of 46, and the seconds probably (after the correction for parallax) 0″.8 instead of 10″.8. Oct. 1 and 2 (*Astronomical Journal*, No. 50, page 12), there is a remark by the observer, that the determination by 6293 of the comparison-star is to be preferred to that by 6294; but I have preferred 6294 for R.A., since Obs. — Comp. from that star harmonizes much better with the general range of Obs. — Comp. For Dec. I have taken the mean. Sept. 16, is the comparison-star **Lalande** 33098 or 33089? In the table of adopted mean places there is 33089. Sept. 17, $\Delta\delta$ must be $-1'\ 57''.52$ instead of $-1'\ 47''.52$, and therefore $\delta = -17^{\circ}\ 11'\ 45''.95$ instead of $35''.95$.

Berlin, Oct. 28. — The seconds of observed δ are probably 37.4, and not 47.4.

Washington, Dec. 13. — The minutes of δ are 11, and not 12.

Washington, 1853, Jan. 7. — The R.A. seems to be erroneous and too great by 1^{s}.

In the formation of the first normal place, only meridian observations are used. All the observations employed in the three normal places harmonize, as you will perceive from Obs. — Comp., so very well with each other, that the normal places must be considered very good; and I confidently believe that the elements I computed from them will finally require but small corrections, and that the Ephemeris II. from them will prove to be very near the truth, though without perturbations. The planet will be found with it without difficulty, and for the formation of further normal places the approximation will be near enough.

In this work I have employed the new tables of logarithms with six decimal places by Dr. **Bremiker**. They are very practical, and save much time and trouble.

The first approximate elements from which the first ephemeris was computed were derived by **Schönfeld** and **Thormann** in Bonn, from observations of June 24, July 16, and August 12. They are: —

1852, July 0, M. T. Berlin.

M	284° 24′ 34″.0	
π	15 10 57.1	Mean Equinox of Epoch.
☊	149 57 53.7	
i	10 9 38.0	
φ	12 33 45.7	
Log a	0.361202	
" μ	3.008204	
μ	1019″.070	

1852. Berlin M. T.	α O.	α C.	C. — O.	δ O.	δ C.	C. — O.		
June 29.4750	271° 57′ 44″.3	57′ 46″.0	+1″.7	—8° 29′ 58″ .6	29′ 55″.5	+3″.1	Berlin,	Meridian Observations.
.5113	271 57 6.9	57 12.2	5.3				Cambridge, (Eng.)	
30.4620	271 42 6.9	42 15.7	8.8	33 24 .6	33 17.6	7.0	Berlin,	
.5088	271 41 25.5	41 31.8	6.3	33 30 .3	33 27.5	2.8	Cambridge, (Eng.)	
July 1.4780	271 26 18.2	26 22.9	4.7	37 2 .8	36 56.0	+6.8	Altona,	
.5054	271 25 51.2	25 57.3	6.1	37 1 .4	37 2.0	—0.6	Cambridge, (Eng.)	
2.4747	271 10 47.4	10 51.6	4.2	40 45 .5	40 40.6	+4.9	Altona,	
3.4712	270 55 26.2	55 28.2	2.0	44 37 .7	44 35.1	2.6	"	
.4985	270 55 0.6	55 2.9	2.9	44 43 .7	44 41.6	2.1	Cambridge, (Eng.)	
4.4562	270 40 26.1	40 21.1	5.0	48(28).7	48 36.5	2.2	Kremsmünster,	
.4677	270 40 8.5	40 10.5	2.0	48 45 .0	48 39.4	5.6	Hamburg,	
.4678	270 40 9.7	40 10.5	0.8	48 41 .0	48 39.4	1.6	Altona,	
.4757	270 40 2.8	40 3.2	0.4	48 42 .0	48 41.4	0.6	Bonn,	
5.4644	270 24 57.1	25 2.6	+5.5	52 55 .1	52 53.2	1.9	Altona,	
.4643	270 25 3.2	25 2.6	—0.5	52 59 .9	52 53.2	6.7	Hamburg,	
.4644	270 24 57.0	25 2.6	+5.6	52 56 .7	52 53.2	3.5	Göttingen,	
.4722	270 24 55.3	24 55.5	+0.2	—8 52 59 .2	52 55.2	+4.0	Bonn,	

Geocentric normal place, July 1.0, reduced to the mean equinox of 1853.0,

$$\alpha = 271^\circ\ 34'\ 27''.44 \qquad \delta = -8^\circ\ 35'\ 16''.55.$$

1852. Berlin M. T.	α O.	α C.	C. — O.	δ O.	δ C.	C. — O.	
Sept. 1.5910	266° 53′ 44″.3	53′ 25″.8	—18″.5	—15° 26′ 20″.5	26′ 20″.3	+0″.2	Washington.
2.6167	267 4 30.8	4 16.5	14.3	16 33 35.9	33 35.3	0.6	"
7.5687	268 3 21.9	3 9.5	12.4	7 49.1	7 47.1	2.0	"
13.5643	269 28 52.9	28 29.2	23.7	16 47(10.8)	47 4.4	(+6.4)	"
16.5791	270 17 17.2	16 55.7	21.8	17 5 46.7	5 49.5	—2.8	"
17.5596	270 33 50.3	33 31.5	18.8	11 42.0	11 46.2	4.2	"
18.5445	270 50 42.0	50 24.3	17.7	17 37.6	17 39.8	2.2	"
19.5526	271 8 28.2	8 8.7	19.5	23 33.4	23 36.9	3.5	"
22.5503	272 3 32.6	3 7.5	25.1	17 40 41.5	40 48.5	7.0	"
26.5271	273 21 25.8	20 59.6	26.2	18 2 13.0	2 20.4	7.4	"
27.5487	273 42 19.6	41 52.1	27.5	7 32.0	7 37.0	5.0	"
28.5391	274 2 52.6	2 25.8	26.8	12 32.6	12 37.7	5.1	"
29.5364	274 43 56.2	23 27.6	28.6	17 28.1	17 34.3	6.2	"
30.5302	274 45 15.0	44 44.3	30.7	22 15.9	22 23.7	7.8	Berlin.
Oct. 1.5335	275 7(13.6)	6 34.4	(39.2)	27 1.1	27 9.4	8.3	
2.5221	275 28(59.3)	28 19.5	(39.8)	18 31 37.5	31 46.1	8.6	
16.2989	281 2 38.6	2 0.4	38.2	19 23 50.4	23 58.2	7.8	
19.2691	282 21 19.6	20 41.7	37.9	31 57.9	32 9.6	—11.7	
28.2691	286 32 25.7	31 41.2	—44.5	—19 49(17.4)	49 45.2	(+ 2.2)	

Geocentric normal place, October 1, reduced to mean equinox of 1853.0,

$$\alpha = 274^\circ\ 55'\ 54''.21 \qquad \delta = -18^\circ\ 24'\ 30''.50.$$

Berlin M. T.	α O.	α C.	C. — O.	δ O.	δ C.	C. — O.	
1852, Dec. 12.5118	310° 58′ 17″.1	57′ 34″.1	—43″.0	18° 16′ 48″.7	17′ 15″.9	—27″.2	Washington.
13.4862	311 32 23.5	31 34.9	48.6	18(12)33.7	11 50.9	27.2	"
17.4979	313 52 53.5	52 13.4	40.1	17 47 37.8	48 4.5	26.7	"
18.4873	314 27 48.8	27 2.8	46.0	17 41 24.8	41 51.0	26.2	"
29.5049	320 58 39.7	57 47.8	51.9	16 22 53.8	23 12.8	19.0	"
1853, Jan. 2.4959	323 21 11.2	20 26.1	45.1	15 50 11.4	50 39.5	28.1	"
4.4982	324 32 56.4	32 9.8	46.6	15 33 8.0	33 32.7	24.7	"
7.4955	326 20(45.7)	19 43.5	(62.2)	15 6 31.1	6 59.1	28.0	"
16.4995	331 44 37.5	43 47.2	50.3	13 40 11.1	40 45.9	34.8	"
17.4995	332 20 36.9	19 50.0	—46.9	13 30 0.5	30 37.6	—37.1	"

Geocentric normal place, 1853, January 1.0, reduced to the mean equinox of 1853.0,

$$\alpha = 322°\ 27'\ 57''.18 \qquad \delta = -16°\ 2'\ 43''.43.$$

From the above normal places I deduced the following

Elements II.

1853, January 0, M. T. Berlin.

M 336° 38′ 1″.8 for Washington 336° 42′ 17″.4.
π 15 1 14.0 } Mean Eq. epoch.
☊ 149 59 35.9 }
i 10 9 28.1
φ 12 34 42.3
Log a 0.361552
" μ 3.007679
μ 1017″.839

Ephemeris II.

12h. M. T. Washington.	⑱ α	⑱ δ	Log △	Log r
1853, Dec. 15	135° 52′ 16″.2	+7° 58′ 19″.0	0.18810	0.35822
17	45 33.8	8 1 42.5	.18390	
19	36 56.1	5 56.3	.17983	0.36011
21	26 22.9	11 1.6	.17589	
23	135 13 54.8	16 59.4	.17211	0.36198
25	134 59 33.2	23 50.0	.16850	
27	43 20.7	31 33.2	.16509	0.36384
29	25 20.8	40 8.6	.16188	
31	134 5 37.4	49 35.3	.15890	0.36567
1854, Jan. 2	133 44 15.5	8 59 52.3	.15616	
4	133 21 20.4	9 10 58.0	.15368	0.36749
6	132 56 58.2	22 50.4	.15147	
8	31 15.8	35 27.4	.14954	0.36930
10	132 4 20.2	9 48 46.4	.14792	
12	131 36 19.2	10 2 41.8	.14661	0.37109
14	131 7 20.9	17 19.5	.14562	
16	130 37 33.8	32 27.3	.14497	0.37285
18	130 7 6.8	10 48 4.6	.14465	
20	129 36 9.5	11 4 7.9	.14468	0.37460
22	129 1 52.1	20 33.2	.14506	
24	128 33 24.3	37 16.7	.14580	0.37633
26	128 1 56.1	11 54 14.4	.14689	
☍ 28	127 30 38.4	12 11 22.2	.14833	0.37805
30	126 59 41.7	28 35.9	.15013	
Feb. 1	126 29 16.6	12 45 51.4	.15227	0.37974
3	125 59 33.2	+13 3 4.7	0.15474	

12^h M. T. Washington.	⑱ α	⑱ δ	Log $\triangle$	Log r
1854, Feb. 5	125° 30′ 40″.7	+13° 20′ 12″.1	0.15754	0.38141
7	125 2 47.4	37 10.3	.16065	
9	124 36 0.7	13 53 55.6	.16406	0.38307
11	124 10 27.4	14 10 24.9	.16776	
13	123 46 14.5	26 35.7	.17173	0.38470
15	23 28.5	42 25.6	.17596	
17	123 2 14.3	14 57 52.6	.18043	0.38632
19	122 42 36.0	15 12 54.7	.18512	
21	21 37.9	27 30.1	.19003	0.38791
23	122 8 23.8	41 37.3	.19513	
25	121 53 56.8	15 55 15.1	.20040	0.38948
27	41 19.6	16 8 22.3	.20583	
Mar. 1	30 33.3	20 57.9	.21140	0.39104
3	21 38.7	33 1.4	.21711	
5	14 36.4	44 32.0	.22292	0.39257
7	9 26.1	16 55 29.5	.22883	
9	6 7.1	17 5 53.6	.23482	0.39408
11	4 38.1	15 41.3	.24089	
13	4 57.4	25 1.8	.24700	0.39557
15	7 3.0	33 46.2	.25316	
17	10 53.3	41 57.7	.25936	0.39704
19	16 26.4	49 36.5	.26558	
21	23 40.0	17 56 42.8	.27181	0.39849
23	32 31.7	18 3 17.1	.27805	
25	42 59.1	9 19.6	.28428	0.39992
27	121 55 0.1	14 50.6	.29051	
29	122 8 32.1	19 50.3	.29672	0.40132
31	23 32.8	24 19.0	.30290	
April 2	39 59.0	28 17.2	.30906	0.40271
4	122 57 47.7	31 45.4	.31517	
6	123 16 55.6	34 44.1	.32125	0.40407
8	37 19.7	37 13.7	.32727	
10	123 58 57.2	39 14.7	.33325	0.40541
12	124 21 45.3	40 47.4	.33917	
14	124 45 41.3	41 52.3	.34503	0.40673
16	125 10 42.4	42 29.7	.35083	
18	125 36 46.1	42 40.2	.35657	0.40803
20	126 3 49.8	42 24.1	.36225	
22	126 31 51.1	41 41.9	.36786	0.40931
24	127 0 47.8	40 33.8	.37340	
26	127 30 38.0	39 0.2	.37887	0.41057
28	128 1 20.1	37 1.3	.38427	
30	128 32 52.6	+18 34 37.4	0.38960	0.41180

COMET I. 1854.

LETTER OF PROFESSOR ALEXANDER TO THE EDITOR.

Princeton, N. J., 1854, *February* 1.

I HAVE obtained another orbit for this comet founded upon the following observations of Mr. VAN ARSDALE.

		R.A.	Dec. N.
	h. m.	h. m. s.	° ′
1853, Nov. 30	9 5	1 41	54 10
Dec. 27	6 40	1 5 40	23 53
1854, Jan. 21	6 43	1 10 30	8 10

From these we have, —

T 1854, Jan. $5^d.77967$ M. T. Greenwich.

π 55° 15′ 7″ } from the Mean Equinox of Jan. 1.

Ω 227 5 27 }

i 66 11 53

Log q 0.3097879 $q = 2.040741$

Motion Retrograde.

For the middle observation these give, —

C. — O.
$d\lambda +14' \; 34'' \quad d\beta +9' \; 46''$

The last observation is well-conditioned for the determination of ☊ and i, the heliocentric latitude being but 0° 36′ 57″.

Observations by Mr. Van Arsdale.

M. T. Newark.			R.A.			Dec. N.		
d.	h.	m.	h.	m.	s.	°	′	
1853, Nov. 25	6	50	2	7		60	12	
30	9	5	1	41		54	10	
Dec. 3	8	43	1	31		50	29	
4	8	36	1	31		49	12	
6	8	21	1	26		46	43	
8	8	13	1	23		41	13	At Transit.
9	8	6	1	21	30	43	2	
10	8	0	1	18		41	48	
12	7	50	1	16		39	24	

M. T. Newark.			R.A.			Dec. N.		
d.	h.	m.	h.	m.	s.	°	′	
1853, Dec. 14	5	50	1	14		37	4	
15	6	19	1	13		35	58	
20	7	10	1	8		30	28	At Transit.
22	7	0	1	6		28	30	
27	6	40	1	5	40	23	53	
29	6	32	1	5	30	22	12	
1854, Jan. 2	6	16	1	5	0	19	0	
3	6	12	1	4	50	18	20	
4	6	8	1	4	50	17	39	
9	7	33	1	5	30	14	22	
21	6	43	1	10	30	8	10	
23	6	30	1	12		7	25	
24	6	21	1	13		7	1	

OBSERVATIONS OF IRENE, MELPOMENE, AND ASTRÆA,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

BY MR. JAMES FERGUSON.

[Communicated by Lieutenant Maury. — Corrected for refraction.]

IRENE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑭ — *		⑭'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1853, Nov. 7	10 17 47.2	4	B. A. C. 1437	+1 28.91	+ 3 50.11	4 32 23.43	+15 41 19.87
14	9 43 38.7	8	Rümker 1235	+1 46.54	— 1 24.84	4 26 15.30	15 40 7.33
	9 46 23.0	7	B. A. C. 1102	+2 44.31	+ 8 3.23	4 26 15.39	15 40 9.67
25	9 18 54.9	6	" 1366	—2 4.57	+ 3 53.61	4 15 12.30	15 40 7.02
26	9 29 14.1	4	" 1366	—3 8.39	+ 4 3.80	4 14 8.90	15 40 17.20
Dec. 14	9 57 41.0	8	B. Z. 337, 86	—0 19.23	—22 3.93	3 56 0.08	15 51 17.93
15	8 2 29.9	6	"	—1 8.24	—20 59.56	3 55 11.78	15 52 22.28
	9 13 34.4	4	"	—1 10.97	—20 55.62	3 55 8.34	15 52 26.22
20	7 52 6.7	5	Rümker 1023	+1 52.88	—12 0.12	3 51 1.13	15 59 18.15
24	7 19 49.7	8	"	+1 58.43	— 5 15.02	3 48 6.65	16 6 3.20
27	9 40 28.6	8	"	—0 0.47	+ 2 9.75	3 46 7.78	16 13 27.93
1854, Jan. 3	8 6 14.2	10	B. Z. 337, 68	+2 56.91	— 1 45.62	3 42 39.06	16 28 45.91
4	7 50 50.8	6	"	+2 34.05	+ 0 52.54	3 42 16.20	+16 31 24.17

Adopted Mean Places, 1850.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 1437	5	4 30 42.03	+15 36 56.7	B. A. Catalogue.
Rümker 1235	9	4 21 15.41	15 40 57.34	Rümker's Catalogue.
B. A. C. 1402	(5.6)	4 23 17.75	15 31 31.08	B. A. Catalogue, and Rümker's Cat.
" 1366	7	4 17 3.78	15 35 36.40	" " "
B. Z. 337, 86	9	3 56 5.70	16 12 38.82	Bessel's Zones.
Rümker 1023	(6.7)	3 45 54.71	16 10 32.43	Rümker's Catalogue.
B. Z. 337, 68	8	3 39 28.66	+16 29 44.01	Bessel's Zones.

MELPOMENE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑱ — *		⑱'s apparent	
				Δ α	Δ δ	α	δ
1854.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Jan. 4	10 2 21.6	5	Weisse VIII. 1367	+1 53.15	+0 57.00	8 54 58.68	+ 9 7 57.95
	*	*	*	*	*	*	*
28	9 54 19.7	6	Weisse VIII. 828	—0 20.40	+5 11.61	8 31 30.87	+12 8 40.48

Adopted Mean Places, 1850.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse VIII. 1367	9	8 52 52.35	+ 9 7 53.43	Weisse's Catalogue.
" 828	8	8 31 38.53	+12 4 18.02	" "

ASTRÆA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑤ — * Δα	⑤ — * Δδ	⑤'s apparent α	⑤'s apparent δ
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
(1) Oct. 3	10 31 31.2	5	B. A. C. 789	+4 9.39	+ 8 51.25	2 31 29.14	+6 58 51.25
(1) 4	9 12 43.1	7	" 800	+2 4.89	—11 56.45	2 30 55.50	6 53 34.51
6	10 22 23.1	5	" 789	+2 17.86	— 7 57.97	2 29 37.66	6 42 2.16
7	9 36 17.1	6	" 789	+1 39.35	—13 35.53	2 28 59.11	6 36 24.65
(1) 19	10 9 27.8	4	Weisse II. 312	+0 15.86	— 9 4.53	2 19 38.71	5 25 7.79
	10 7 45.1	3	" 333	—0 50.91	+ 1 5.36	2 19 38.67	5 25 6.61
31	9 51 30.7	6	B. A. C. 687	+2 59.55	— 2 39.21	2 8 50.46	4 17 2.02
Nov. 1	10 19 20.9	5	" 687	+2 3.57	— 7 53.05	2 7 54.49	4 11 48.38
	10 22 38.4	4	Weisse II. 102	+0 33.51	+ 0 37.47	2 7 54.94	4 11 47.38
7	9 9 56.8	14	B. A. C. 663	+0 34.57	+11 13.61	2 2 38.13	3 43 33.87
14	8 13 0.7	5	Weisse I. 984	+1 50.06	+ 8 30.40	1 56 56.96	3 16 56.84
		5	" 1056	—2 14.75	+ 4 36.63	1 56 56.88	3 16 55.33
25	8 48 40.2	6	" 860	+1 40.81	+ 0 31.60	1 49 43.85	2 52 11.76
26	9 3 23.8	6	" 860	+1 9.05	— 0 32.69	1 49 12.09	2 51 4.42
Dec. 5	9 23 37.3	2	B. A. C. 574	—0 19.84	+22 0.58	1 45 39.60	2 19 49.85
	9 36 21.8	6	Weisse I. 847	—1 33.06	+ 9 29.94	1 45 39.86	2 49 54.10
13	9 44 51.3	4	B. A. C. 551	+3 33.07	+ 4 36.20	1 44 25.13	3 1 48.99
14	8 43 47.4	6	" 551	+3 31.40	+ 6 50.37	1 44 23.45	3 4 3.10
15	7 13 7.6	6	" 551	+3 31.15	+ 9 7.58	1 44 23.20	3 6 20.13
24	8 51 40.0	3	Weisse I. 778	+2 9.41	+ 6 27.79	1 45 34.17	+3 36 14.77

Adopted Mean Places, 1850.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 789	(5.6)	2 27 7.81	+6 48 56.26	B. A. Catalogue; 660 Rümker.
" 800	7	2 28 38.65	7 4 27.48	B. A. Catalogue; Santini.
Weisse II. 312	8	2 19 10.75	5 33 6.67	Weisse's Catalogue.
" 333		2 20 17.48	5 22 55.78	" "
B. A. C. 687	7	2 5 38.77	4 18 33.52	B. A. Catalogue; Santini; Madras.
Weisse II. 102		2 7 9.28	4 10 2.45	Weisse's Catalogue.
B. A. C. 663	(6.7)	2 1 51.43	3 31 12.13	B. A. Catalogue; Weisse; Madras.
Weisse I. 984		1 54 54.78	3 7 17.76	Weisse's Catalogue.
" 1056		1 58 59.47	3 11 10.63	" "
" 860	9	1 47 50.97	2 50 28.14	" "
B. A. C. 574		1 45 47.52	2 26 40.58	B. A. Catalogue, and Santini.
(2) Weisse I. 847	8	1 47 0.99	2 39 15.62	Washington Mural; Professor Yarnall.
B. A. C. 551		1 40 40.11	2 56 3.91	B. A. Catalogue, and Santini.
Weisse I. 778		1 43 12.87	+3 28 38.96	Weisse's Catalogue.

(1) The observations of October 3, 4, and 19, are published in the *Astronomical Journal*, No. 65. The right-ascensions in that number have an error which is corrected here.

(2) This star is 3526 of Lalande. There is a difference of 1 second in the α between Lalande and Weisse.

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THE

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ON THE CORRECTION OF THE ELEMENTS OF CERES.

BY ERNEST SCHUBERT.

[From a Report to Lieutenant CHARLES HENRY DAVIS, Superintendent Nautical Almanac.]

UPON my arrival at Berlin, I proceeded at once to make a plan upon which the proposed work could be done, so that a satisfactory result might be obtained. I found elements very well determined by Professor ENCKE for 1820, and published in No. 636 of the *Astronomische Nachrichten*. When I then began to collect observations, I saw that observations sufficient for forming normal places could be had from 1832 up to the present time. Professor ENCKE had the kindness to let me have the calculations of the differential coefficients of the perturbations by *Jupiter* from 1820 to 1839, and from 1839 to 1854. I am indebted to Professor WOLFERS for the continuation of those coefficients. By means of those coefficients I got out a set of elements for 1831, July 23.0, M. T. Berlin, as the elements from which to start my work, and for which to find finally the corrections. For that epoch, therefore, I put the integral of the perturbations equal to zero, and formed a new table of integrals, making use only of the already computed coefficients. Starting now from 1851, July 23.0, and employing my new table of integrals, I got out anew the osculating elements for all those epochs for which elements are published in No. 636 of the *Astr. Nachr.*, in order to have out those elements upon one and the same fixed principle, and to find out accidental errors which might have slipped in. Therefore you will find sometimes slight differences between my elements and those published in the *Astr. Nachr.*, since formerly in several years they have neglected the corrections for the secular variation of the obliquity; and from 1846, inclusive, Professor WOLFERS had used differential coefficients which he afterwards computed anew on account of some slight inaccuracy. I have, of course, employed the corrected coefficients. Table III. contains all the observations I could find, compared with the Berlin Ephemeris, for the formation of normal places, I put the weight P of ten observations equal to unity, and h, the measure of precision, $= \sqrt{P}$. The whole number of observations employed is 478, — 250 of R.A. and 220 of Dec. I computed the constants for the coördinates for the equator in the usual manner, and the normal places from my elements also by means of the usual formulas, except that the true anomaly and the radius vector are found by my own method. The coördinates of the sun I did not interpolate, as you will find, but computed them directly for the times of the normal places.

With the differential coefficients computed, and with the differences between the computed and observed normal places, twenty-eight equations of condition were obtained, which equations were multiplied each by its respective h, and combined, forming Combination I. The original equations, allowing each a weight equal to unity, were also combined, forming Combination II. I had made up my mind to solve the equations of condition a second time, because I perceived that the great weight of the normal place for 1844 would be undue to it (the effect of the periodical perturbations of *Saturn* being very considerable in that year), and influence the final results injuriously. That I was quite right in that is shown by the residual errors. The absolute sum of the residuals, after substituting the corrections δM, &c. in the equations of condition, is with Combination I. 257''.01, and with Combination II. 203''.61. The few greater residuals are accounted for by the periodical perturbations by *Saturn*. The mean daily motion μ is known now within very narrow limits, its probable error being only 0''.00075. With the corrections of the elements found in Combination II., I computed the corrected elements of *Ceres* for 1851, Jan. 0, M. T. Washington; and with these elements, and for the meridian of Washington, I will carry on the calculations for *Ceres*. I shall of course now, starting from this new epoch, compute the perturbations both by *Jupiter* and *Saturn*; and I feel quite confident that I can keep *Ceres* in just as good order as *Iris*.

OSCULATING ELEMENTS.

	Berlin M. T. 1831, July 23.0.	1832, Nov. 1.0.	Astr. Nachr.(1)	1834, Feb. 16.0.	Astr. Nachr.(1)	1835, June 11.0.	Astr. Nachr.(1)
L	307° 3′ 50″.49	46° 49′ 1″.08	49′ 0″.3	147° 58′ 44″.71	58′ 46″.2	250° 45′ 53″.22	45′ 54″.1
M	159 25 3.99	257 42 10.65	42 9.8	358 32 32.28	32 35.6	101 10 16.66	10 19.0
π	147 38 46.50	149 6 50.43	6 50.5	149 26 12.43	26 10.6	149 35 36.56	35 35.1
☊	80 53 14.04	80 43 3.36	43 3.1	80 43 41.24	43 40.8	80 44 30.55	44 30.1
i	10 36 58.84	10 36 41.19	36 41.5	10 36 47.03	36 47.3	10 36 47.57	36 47.8
φ	4 24 5.69	4 27 24.56	27 27.7	4 28 23.56	28 23.6	4 29 43.60	29 41.7
μ	769″.28942	770″.94660	.94801	771″.17305	.16251	770″.70420	.72271

	Berlin M T. 1836, Sept. 8.0.	Astr. Nachr (1)	1837, Dec. 9.5.	Astr. Nachr.(1)	1838, July 16.0.	Astr. Nachr.(1)	1839, April 6.0.	Astr. Nachr.(1)
L	348° 10′ 16″.13	10′ 17″.0	86° 11′ 36″.79	11′ 37″.5	133° 1′ 21″.23	1′ 21″.9	189° 31′ 23″.06	31′ 24″.0
M	198 27 36.33	27 38.5	296 14 46.48	14 49.3	343 5 24.90	5 27.9	39 43 28.02	43 31.4
π	149 42 39.80	42 38.5	149 56 50.31	56 48.2	149 55 56.33	55 54.0	149 47 55.04	47 52.6
☊	80 45 11.11	45 10.6	80 45 44.96	46 57.6(2)	80 46 3.60	47 17.1(2)	80 44 22.12	45 38.1(2)
i	10 36 44.91	36 45.1	10 36 47.91	36 47.9	10 36 45.33	36 45.3	10 36 44.92	36 45.0
φ	4 30 48.16	30 48.3	4 31 37.04	31 37.1	4 32 17.54	32 17.6	4 34 17.70	34 17.7
μ	770″.92315	.92389	771″.32254	.32342	771″.11245	.11325	770″.49647	.49733

	Berlin M.T. 1840, July 16.5.	Astr. Nachr.(1)	1841, Oct. 13.0.	Astr. Nachr.(1)	1842, July 5.0.	Astr. Nachr.(1)	1843, Jan. 23.0.	Astr. Nachr.(1)
L	289° 38′ 29″.47	38′ 30″.1	26° 51′ 15″.32	51′ 16″.5	83° 37′ 4″.55	37′ 6″.5	126° 52′ 12″.40	52′ 14″.7
M	140 31 48.35	31 50.5	237 54 18.69	54 20.9	294 49 31.10	49 33.2	338 9 55.28	9 57.9
π	149 6 11.12	6 39.6	148 56 56.63	56 55.6	148 47 33.45	47 33.3	148 42 17.12	42 16.8
☊	80 43 57.23	43 55.9	80 44 54.22	44 54.6	80 45 33.19	45 33.4	80 45 54.51	45 54.3
i	10 37 8.10	37 8.3	10 37 8.08	37 8.2	10 37 6.56	37 7.0	10 37 3.98	37 4.1
φ	4 35 2.25	35 2.4	4 34 18.91	34 19.1	4 33 57.34	33 57.4	4 33 50.92	33 51.0
μ	771″.47825	.47805	771″.23250	.23251	770″.95798	.95795	770″.87289	.87256

	Berlin M. T. 1844, May 20.0.	Astr. Nachr.(1)	1845, Aug. 21.0.	Astr. Nachr.(1)	1846, Nov. 18.0.	Astr. Nachr.(1)	1848, March 12.0.	Astr. Nachr.(1)
L	230° 19′ 5″.79	19′ 7″.0	328° 30′ 52″.34	30′ 55″.1	65° 44′ 23″.25	44′ 24″.1	168° 23′ 13″.03	23′ 13″.5
M	81 52 12.77	52 11.9	180 18 48.36	18 47.1	278 19 32.93	19 17.2	21 4 49.19	4 0.5
π	148 26 53.02	26 55.1	148 12 3.98	12 8.0	147 24 50.32	25 7.2	147 18 23.84	19 13.0
☊	80 46 14.68	46 15.4	80 47 12.44	47 13.3	80 46 54.16	46 54.0	80 47 26.57	47 27.7
i	10 37 5.92	37 6.1	10 37 9.37	37 9.8	10 37 17.02	37 17.2	10 37 12.96	37 13.1
φ	4 33 12.48	37 6.1(3)	4 32 58.20	37 9.8(3)	4 29 43.98	29 43.2	4 24 57.21	24 56.8
μ	771″.30745	.30742	771″.53569	.53524	770″.02180	.02176	770″.98813	.98662

	Berlin M.T. 1849, June 28.0.	Astr. Nachr.(1)	1850, Sept. 25 0.	Astr. Nachr.(1)	1851, Dec. 30.5.	1853, April 20.5.
L	269° 42′ 30″.22	42′ 31″.6	6° 52′ 42″.76	52′ 41″.9	105° 39′ 31″.42	207° 49′ 52″.16
M	122 9 9.72	8 25.5	219 7 13.75	6 29.5	317 40 57.95	59 33 47.75
π	147 33 20.50	34 6.1	147 45 29.01	46 12.4	147 58 33.47	148 16 4.41
☊	80 48 31.23	48 32.8	80 48 45.97	48 46.6	80 49 21.78	80 50 24.89
i	10 37 8.96	37 9.2	10 37 4.16	37 4.4	10 37 9.84	10 37 11.16
φ	4 24 29.56	24 29.4	4 23 46.44	23 46.2	4 23 9.65	4 23 6.68
μ	770″.72361	.72042	770″.45592	.45273	770″.75805	770″.64666

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(1) *Astronomische Nachrichten*, No. 636.

(2) The corrections for the secular variation of the obliquity of the ecliptic are neglected.

(3) By some mistake in writing or printing, the minutes and seconds of i are repeated.

CERES.

Observations compared with the Berlin Ephemeris.

1832.

Date.	Observed R.A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.	° ′ ″	″	″	
1832, Oct. 16.5361	2 52 31.49	32.44	+0.95	+4 36 51.2	46.2	—5.0	Kremsmünster.
20.5231	49 19.07	20.35	1.28	26 10.9	7.8	3.1	"
21.5197	48 29.00	30.23	1.23	23 34.8	34.3	0.5	"
.5314	48 28.41	29.62	1.21	23 32.9	32.4	—0.5	Altona.
22.5281	47 37.49	38.73	1.24	21 1.5	1.6	+0.1	"
25.5038	45 1.46	2.95	1.49	13 57.8	51.4	—6.4	Kremsmünster.
26.5032	44 8.73	9.51	0.78	11 32.1	34.4	+2.3	"
30.4589	40 32.48	34.06	1.58	3 21.3	16.9	—4.4	Wilna.
31.4980	39 35.58	36.73	1.15	4 1 19.2	19.3	+0.1	Altona.
Nov. 6.4778	34 4.31	5.60	1.29	3 52 8.4	5.9	—2.5	"
7.4320	33 11.36	13.10	1.47	51 3.5	50′ 58.8	4.7	Wilna.
8.4286	32 17.16	18.49	1.33	49 58.5	55.4	3.1	"
9.4677	31 20.78	21.90	1.12	48 57.0	57.0	0.0	Altona.
10.4458	30 27.69	28.99	1.30	48 10.8	9.0	1.8	Kremsmünster.
13.4118	27 50.01	51.24	1.23	46 33.5	27.5	6.0	Wilna.
14.4084	26 58.30	59.36	1.06	46 17.8	8.7	9.1	"
15.4051	2 26 6.27	8.06	+1.79	+3 46 3.4	57.7	—5.7	"

1833 not in opposition.

1834.

Date.	Observed R A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.	° ′ ″	″	″	
1834, Jan. 31.5819	10 34 36.69	37.56	+0.87	+25 9 34 .1	24.3	— 9.8	Manheim.
Feb. 1.5788	33 57.22	58.05	0.83	18 2 .1	17′ 49.7	12.4	"
3.5724	32 34.26	35.17	0.91	34 50 .2	33.4	16.8	"
6.5161	30 22.79	23.98	1.19	25 59 9 .9	58 49.9	[20.0]	Wilna.
9.5442	27 58.45	59.47	1.02	26 23 12 .2	22 58.5	13.7	Bogenhausen.
10.5409	27 9.01	10.07	1.06	30 54 .8	42.4	12.4	"
11.5376	26 18.95	19.90	0.95	38 33 .7	18.5	15.2	"
12.5343	25 27.93	29.00	1.07	45 57 .5	46.4	11.1	"
13.4931	24 38.28	39.43	1.15	53 14 .0	52 51.1	[22.9]	Wilna.
.5071	24 37.33	38.71	1.38	26 53 9 .4	52 57.3	12.1	Cracow.
14.4897	23 46.11	47.35	1.24	27 0 20 .0	1.4	18.6	Wilna.
16.5210	21 58.58	59.72	1.14	14 18 .9	5.4	13.5	Bogenhausen.
.5297	21 58.31	59.24	0.93	14 26 .9	11.0	15.9	Manheim.
17.4944	21 6.58	7.61	1.03	20 46 .5	37.2	9.3	Cracow.
.5176	21 5.41	6.35	0.94	20 53 .3	44.6	8.7	Bogenhausen.
18.5143	20 11.73	12.69	0.96	27 21 .9	12.1	9.8	"
19.4877	19 19.20	20.09	0.89	(? 33 31 .0 34 20 .0)	21.5	12.5	Cracow.
.5196	19 17.44	18.36	0.92	33 44 .4	33.3	11.1	Manheim.
20.5075	18 23.81	24.86	1.05	39 42 .8	32.4	10.4	Bogenhausen.
22.5095	16 35.30	36.35	1.05	51 19 .0	7.2	11.8	Manheim.
23.4595	15 43.42	44.99	[1.57]	56 29 .9	17.5	12.4	Wilna.
.4743	15 43.19	44.21	1.02	$56\binom{3}{2}6.3$	22.2	14.1	Cracow.
.5062	15 41.43	42.49	1.06	27 56 44 .5	32.4	12.1	Manheim.
27.4461	12 10.74	11.75	1.01	28 15 55 .6	45.3	10.3	Wilna.
.4609	12 10.09	10.96	0.87	15 59 .1	49.2	9.9	Cracow.
March 1.4542	10 10 26.13	26.84	+0.71	+28 24 15 .5	7.3	— 8.2	"

1835.

Date.	Observed R.A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.	° ′ ″	″	″	
1835, May 28.5791	17 25 54.82	56.19	+1.37	—22 3 27.0	16.9	+10.1	Edinburgh.
29.5757	25 1.35	2.40	1.05	6 8.2	5 55.0	13.2	"
June 2.5143	21 22.17	23.38	1.21	16 26.1	14.1	12.0	Kremsmünster.
3.5110	20 25.52	26.57	1.05	19 4.8	18 49.1	15.7	"
4.5076	19 28.11	29.34	1.23	21 34.5	23.3	11.2	"
.5555	19 25.18	26.58	1.40				Edinburgh.
6.5008	17 32.43	33.91	1.48	26 33.5	28.7	4.8	Kremsmünster.
7.4974	16 34.67	35.84	1.17	29 10.5	59.7	10.8	"
8.4940	15 36.25	37.51	1.26	31 44.7	29.7	15.0	"
.5419	15 33.20	34.70	1.50	31 50.2	36.9	13.3	Edinburgh.
9.4906	14 37.99	39.10	1.11	34 9.9	33 58.7	11.2	Kremsmünster.
.5385	14 35.36	36.29	0.93				Edinburgh.
11.4838	12 40.95	42.17	1.22	39 4.1	38 52.9	11.2	Kremsmünster.
12.4804	11 41.62	42.75	1.13	41 28.4	18.0	10.4	"
13.5249	10 41.62	42.73	1.11	22 44 1.2	43 48.9	12.3	Edinburgh.
22.4471	17 2 15.51	16.67	1.13	23 4 28.0	21.7	6.3	Kremsmünster.
25.4842	16 59 34.05	35.55	+1.50	—23 11 12.4	10 59.2	+13.2	Edinburgh.

1836.

Date.	Observed R A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.	° ′ ″	″	″	
1836, Aug. 22.6030	23 44 14.80	15.79	+0.99	—18 39 58.2	51.7	+6.5	Edinburgh.
24.5967	42 54.93	55.91	0.98	18 53 30.2	21.5	8.7	"
27.5870	40 48.19	49.28	1.09	19 13 28.4	16.7	11.7	"
29.5806	39 19.65	20.69	1.04	26 24.9	16.1	8.8	"
31.5262	37 50.82	51.42	0.60	38 48.2	39.4	8.8	Kremsmünster.
.5653	37 48.97	49.61	0.64	39 3.5	38 54.1	9.4	Greenwich.
Sept. 1.5229	37 4.10	4.68	0.58	45 5.4	41 52.8	12.6	Kremsmunster.
.5621	37 2.11	2.84	0.73	45 16.9	7.3	9.6	Greenwich.
.5709	37 1.60	2.42	0.82	45 19.2	10.6	8.6	Edinburgh.
2.4887	36 17.88	18.83	0.95	50 56.3	49.2	7.1	Wilna.
.5588				19 51 23.7	14.8	8.9	Greenwich.
5.4789	33 52.57	53.75	1.27	20 8 43.1	34.5	8.6	Wilna.
.4937	33 52.54	53.02	0.48	8 52.1	39.7	12.4	Cracow.
6.4904	33 3.39	3.80	0.41	14 38.0	20.6	17.4	"
7.4732	32 14.27	14.88	0.61	20 0.7	19 49.6	11.1	Helsingfors.
.4723	32 13.32	14.93	[1.61]	19 59.7	49.2	10.5	Wilna.
10.4621	29 43.27	44.57	1.30	35 51.9	39.9	12.0	"
.5324				36 14.2	1.3	12.9	Greenwich.
11.4590	28 52.61	54.08	1.47	40 46.4	39.3	7.1	Wilna.
13.4521	27 11.65	13.01	1.36	50 19.3	9.1	10.2	"
.5221	27 8.59	9.46	0.87	50 38.9	28.4	10.5	Greenwich.
.5312	27 7.76	9.01	1.25	50 38.3	30.9	7.4	Edinburgh.
14.4191	26 21.57	22.48	0.91	20 54 50.6	39.2	11.4	Wilna.
16.4424	24 40.66	41.82	1.16	21 3 19.6	7.9	11.7	"
.4572	24 40.52	41.06	0.54	3 27.4	11.6	15.8	Cracow.
17.4391	23 50.40	51.74	1.34	7 14.3	6.3	8.0	Wilna.
.5180	23 46.65	47.79	1.14	7 30.3	24.7	5.6	Edinburgh.
20.5080	21 18.22	19.49	1.27	18 14.4	10.2	4.2	"
21.5047	23 20 29.64	30.81	+1.17	—21 21 26.4	22.4	+4.0	"

1837.

Date.	Observed R A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	m. s.	s.	° ′ ″	″	″	
1837, Nov. 23.5070	5 22 58.89	23 0.58	[+1.69]	+21 18 25.0	1.5	—23.5	Wilna.
.5859	22 55.32	56.47	1.15				Edinburgh.
24.5826	22 2.97	4.05	1.08	21 14.9	20′ 57.9	17.0	“
27.5726	19 19.30	20.31	1.01				“
28.5692	18 22.69	23.81	1.12	32 10.7	31 52.5	18.2	“
30.5625	16 27.53	28.14	0.61	37 39.4	19.6	19.8	“
Dec. 1.5174	15 30.80	31.71	0.91	40 20.3	39 55.8	24.5	Padua.
.5503	15 29.16	29.74	0.58	40 22.4	1.2	21.2	Greenwich.
.5591	15 28.23	29.21	0.98	40 21.2	2.7	18.5	Edinburgh.
2.5140	14 31.28	32.09	0.81	43 2.0	42 38.6	23.4	Padua.
4.5072	12 30.31	31.16	0.85	48 23.3	2.8	20.5	“
.5488	12 27.59	28.59	1.00	21 48 28.8	9.6	19.2	Edinburgh.
9.5317	7 18.66	19.47	0.81	22 1 49.8	29.4	20.4	“
12.5213	4 11.42	12.42	1.00	9 38.0	19.9	18.1	“
13.5179	3 9.09	10.20	1.11	12 14.2	11 55.0	19.2	“
14.4727	2 10.20	10.79	0.59	14 48.8	22.7	26.1	Padua.
15.4630	1 8.35	9.50	1.15	17 15.4	16 55.0	20.4	Kremsmünster.
.4693	1 8.11	9.13	1.02	17 15.1	16 56.0	19.4	Padua.
.5110	1 5.52	6.53	1.01	17 22.0	2.4	19.6	Edinburgh.
16.5075	5 0 4.35	5.16	0.81	19 52.8	34.7	18.1	“
17.4252	4 59 7.70	9.08	[1.38]	22 13.5	21 54.1	19.4	Wilna.
18.5006	58 2.84	3.85	1.01				Edinburgh.
22.4081	54 11.57	13.17	[1.60]	34 41.8	18.9	22.9	Wilna.
23.4047	53 14.68	16.23	[1.55]	37 7.2	36 45.5	21.7	“
.4835	53 10.76	11.76	1.00	37 15.9	36 57.1	18.8	Edinburgh.
24.4013	4 52 18.91	20.27	[1.36]	+22 39 38.7	11.5	—27.2	Wilna.

1838 not in opposition.

1839.

Date.	Observed R.A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.	° ′ ″	″	s.	
1839, March 21.6066	13 36 20.58	18.49	—2.09	+6 41 0.8	23.1	+22.3	Edinburgh.
24.5491	34 16.07	13.61	2.46	6 58 38.8	59′ 2.2	23.4	Kremsmünster.
25.5938	33 29.25	27.15	2.10	7 3 40.3	4 5.4	25.1	Edinburgh.
27.5785	31 58.48	56.15	2.33	13 2.5	27.1	24.6	Greenwich.
29.5808	30 23.29	21.07	2.22	22 7.5	32.3	24.8	Edinburgh.
30.5775	29 34.94	32.62	2.32	26 30.7	54.8	24.1	“
31.5262	28 48.12	45.93	2.19	30 33.2	58.3	25.1	Kremsmünster.
April 6.5455	23 41.24	38.81	2.43	7 53 40.5	54 6.2	25.7	Greenwich.
9.5443	21 3.93	1.73	2.20				Edinburgh.
10.5321	20 12.22	9.79	2.43	8 6 3.2	28.1	24.9	Greenwich.
15.5242	15 51.07	48.95	2.12				Edinburgh.
16.4729	15 1.96	0.09	1.87	19 19.7	42.0	22.3	Kremsmünster.
17.5176	14 9.32	6.72	2.60				Edinburgh.
18.5142	13 18.73	16.32	2.41	22 14.2	40.6	26.4	“
19.5109	12 28.71	26.39	2.32				“
20.4988	11 39.65	37.49	2.16	24 19.2	45.7	26.5	Greenwich.
.5076	11 39.57	37.05	—2.52	+8 24 18.4	46.2	+27.8	Edinburgh.

For 1840, I could find only three observations.

1841.

Date.	Observed R.A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.	° ′ ″	″	″	
1841, Sept. 29.5365	1 45 49.85	52.41	+2.56	—4 20 49.0	33.5	+15.5	Kremsmünster.
.5844	45 47.61	50.34	2.73	21 3.1	20 46.5	16.6	Edinburgh.
30.5812	45 2.87	5.68	2.81	25 37.6	20.5	17.1	"
Oct. 2.5268	43 33.59	36.15	2.56	34 21.5	7.2	14.3	Kremsmünster.
7.5104	39 31.65	34.48	2.83	4 55 46.7	29.5	17.2	"
11.4872	36 8.67	11.37	2.70	5 11 18.9	3.8	15.1	"
.5451	36 5.83	8.89	3.06	11 29.4	14.4	15.0	Edinburgh.
12.5330	35 14.92	17.64	2.72	15 7.1	14 50.1	17.0	Greenwich.
.5418	35 14.57	17.18	2.61	15 6.7	14 52.0	14.7	Edinburgh.
13.5385	34 22.47	25.21	2.74	18 38.2	22.7	15.5	"
15.5318	32 38.22	40.81	2.59	25 14.9	1.8	13.1	"
18.4738	30 3.23	6.26	3.03	34 10.9	33 52.7	18.2	Kremsmünster.
.5218	30 0.87	3.73	2.86	34 14.7	0.8	13.9	Edinburgh.
19.4258	29 13.45	16.34	2.89	36 47.7	28.7	19.0	St. Petersburg.
.5097	29 8.97	11.95	2.98	36 57.7	42.1	15.6	Greenwich.
21.5118	27 24.81	27.55	2.74				Edinburgh.
22.4157	26 37.83	40.71	2.88	44 6.7	43 44.8	21.9	St. Petersburg.
23.4124	25 46.99	49.43	2.44	46 10.4	45 51.3	19.1	"
.4572	25 44.47	47.13	2.66	46 17.1	45 56.7	20.4	Kremsmünster.
25.4057	24 5.24	7.93	2.69	49 54.8	35.0	19.8	St. Petersburg.
.4896	24 1.14	3.69	2.55				Greenwich.
.4984	24 0.42	3.29	2.87	49 58.7	41.3	14.4	Edinburgh.
26.4951	23 10.45	13.26	2.81				"
27.4438	22 23.56	26.11	2.55	53 2.6	52 42.3	20.3	Kremsmünster.
28.4885	1 21 32.20	34.86	+2.66	—5 54 14.8	1.5	+13.3	Edinburgh.

1843.

Date.	Observed R.A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.	° ′ ″	″	″	
1843, Jan. 10.5854	8 42 44.75	42.27	—2.48	+29 16 59.4	57.7	—1.7	Cambridge (Eng.).
11.5822	41 54.99	52.39	2.60	29 24 51.0	51.1	+0.1	"
16.5651	37 30.13	27.64	2.49	30 3 19.3	17.8	—1.5	"
17.5622	36 34.47	32.01	2.46	10 46.1	43.9	2.2	"
.5712	36 34.04	31.51	2.53				Edinburgh.
18.5588	35 38.37	35.68	2.69	18 5.0	3.7	1.3	Cambridge (Eng.).
20.5611	33 43.02	40.69	2.33				Edinburgh.
24.5384	29 49.46	46.97	2.49	30 59 27.4	25.0	2.4	Cambridge (Eng.).
.5475	29 48.85	46.37	2.48	30 59 31.7	28.9	2.8	Edinburgh.
28.5247	25 52.76	50.04	2.72	31 24 2.9	23 59.3	3.6	Cambridge (Eng.).
30.5179	23 54.92	52.33	2.59	35 17.3	11.1	6.2	"
.5182	23 54.70	52.31	2.39	35 18.3	13.2	5.1	Greenwich.
.5270	23 54.27	51.79	2.48	35 20.5	16.0	—4.5	Edinburgh.
Feb. 1.4722	22 0.62	m. 21 58.28	2.34	45 29.8	30.7	+0.9	Kremsmünster.
.5201	21 57.96	55.50	2.46	45 50.3	45.3	—5.0	Edinburgh.
2.5076	21 1.26	20 58.62	2.64	50 41.4	39.9	4.5	Cambridge (Eng.).
3.5042	20 4.53	1.87	2.66	31 55 27.5	25.3	2.2	"
.5133	20 3.97	1.36	2.61				Edinburgh.
6.4950	17 18.50	15.95	2.55	32 8 31.4	30.1	1.3	Greenwich.
7.4519	16 27.00	24.52	2.48	12 19.0	17.8	1.2	Kremsmünster.
8.4185	8 15 33.63	31.92	[—1.71]	+32 16 8.8	3.1	—5.7	"

1844.

Date.	Observed R.A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.	° ′ ″	′ ″	″	
1844, May 5.5390	16 9 25.03	20.96	—4.07	—11 6 1.7	5 39.0	+22.7	Kremsmünster.
.5505	9 24.12	20.37	3.75	6 1.4	39.1	22.3	Hamburg.
6.5195	8 35.91	31.56	[4.35]	6 30.4	5 54.2	[36.2]	Cracow.
.5357	8 34.58	30.76	3.82	6 10.3	54.4	15.9	Kremsmünster.
.5472	8 34.14	30.18	3.96	6 17.5	54.7	22.8	Hamburg.
.5746	8 32.71	28.76	3.95	6 18.0	55.1	22.9	Cambridge (Eng.).
.5748	8 32.81	28.76	4.05	6 18.2	55.1	23.1	Greenwich.
7.5439	7 42.97	39.12	3.85	6 35.1	11.3	23.8	Hamburg.
.5803	7 41.20	37.26	3.94	6 35.2	12.0	23.2	Edinburgh.
8.5291	6 51.03	47.88	[3.15]	6 47.1	29.2	17.9	Kremsmünster.
.5403	6 51.12	47.30	3.82	6 54.1	29.5	21.6	Hamburg.
9.5373	5 58.67	54.69	3.98	7 12.4	6 48.9	23.5	"
10.5063	5 7.29	2.89	[4.40]	7 41.0	9.3	[31.7]	Cracow.
11.5191	4 11.92	8.11	3.81	7 53.9	32.3	21.6	Kremsmünster.
12.5157	3 17.14	13.64	3.50	8 21.4	7 56.6	24.8	"
.5272	3 16.84	13.02	3.82	8 21.9	56.9	25.0	Hamburg.
13.5512	2 20.60	16.51	4.09	8 47.4	23.7	23.7	Cambridge (Eng.).
.5514	2 20.51	16.51	4.00	8 47.2	23.7	23.5	Greenwich.
15.5171	0 30.64	26.77	3.87	9 41.3	20.8	23.5	Hamburg.
.5536	16 0 28.89	24.69	4.20	9 47.3	22.0	25.3	Edinburgh.
16.5138	15 59 34.56	30.60	3.96	10 16.2	9 52.9	23.3	Hamburg.
.5411	59 33.21	29.07	4.14	10 18.5	53.8	24.7	Cambridge (Eng.).
17.5377	58 36.88	32.64	4.24				"
.5379	58 36.66	32.64	4.02	10 50.1	28.0	22.1	Greenwich.
18.4793	57 43.61	39.18	[4.43]	11 31.3	2.5	[28.8]	Cracow.
.4955	57 42.53	38.22	4.31	11 25.4	3.1	22.3	Kremsmünster.
.5434	57 39.72	35.54	4.18	11 29.4	4.8	24.6	Edinburgh.
20.5367	55 45.99	41.96	4.03				"
21.5333	54 49.18	45.20	3.98	13 33.9	8.7	25.2	"
22.4934	53 51.41	50.55	3.86	14 19.1	13 53.2	25.9	Hamburg.
22.5299	53 52.45	48.44	4.01				Edinburgh.
23.4901	52 57.95	m. 53.91	4.04	15 6.1	14 42.0	24.1	Hamburg.
24.4867	52 1.01	51 57.46	3.55	15 58.2	33.5	24.7	"
25.5197	51 3.13	50 59.26	3.87	16 54.2	29.9	24.3	Edinburgh.
26.4800	50 9.10	5.46	3.64	17 52.2	25.2	27.0	Hamburg.
27.5039	49 12.61	8.45	4.16	18 52.8	27.2	25.6	Cambridge (Eng.).
27.5041	49 12.38	8.45	3.93	18 52.7	27.2	25.5	Greenwich.
29.4697	47 24.31	20.32	3.99	20 59.5	35.5	24.0	Hamburg.
30.4664	46 30.11	26.30	3.81	22 10.0	21 45.2	24.8	"
31.4904	45 35.40	31.38	4.02	23 25.2	0.2	25.0	Cambridge (Eng.).
June 1.4474	44 41.53	40.67	3.86	24 38.3	13.5	24.8	Kremsmünster.
.4873	44 42.41	38.56	3.88	24 41.5	16.7	24.8	Greenwich.
3.4894	15 42 58.47	54.65	—3.82	—14 27 26.7	0.6	+26.1	Edinburgh.

(To be continued.)

OBSERVATIONS ON VAN ARSDALE'S COMET, MADE AT THE OBSERVATORY OF HARVARD COLLEGE.

	Cambridge M. S. T.	$\Delta\alpha$ ☄ — *	$\Delta\delta$ ☄ — *	Comparison-Star.
	h. m. s.	m. s.	′ ″	
1853, Dec. 14	12 52 28.4	—1 24.24	—7 8.1	*a*
15	6 51 23.9	+1 16.74	+6 14.3	*b*
21	7 32 21.2	+0 16.63	+2 30.7	*c*
27	7 0 46.8	+0 2.15	+5 0.5	*d*
1854, Jan. 2	7 8 58.8	+0 42.50	+6 13.6	*e*

Mean Places of Comparison-Stars referred to the Mean Equinox of the beginning of the Years 1853 *and* 1854.

Star.	α 1853.0. h. m. s.	δ 1853.0. ° ′ ″	Authority.
a	1 15 17.01	+36 56 48.1	B. A. C. 409.
b	1 12 10	35 59	Approximate 9 magnitude.
c	1 6 40	26 36	" "
d	1 5 46.42	23 48 17.7	B. A. C. 365.
e	1 4 33.35	+18 57 48.0	10 mag. compared with B. A. C. 336.

W. C. BOND.

PROFESSOR A. C. PETERSEN.

For the fourth time in the few years since our Journal was established has the voice of a constant contributor been silenced in death.

A letter from Mr. Richard Schumacher imposes upon the Editor of this Journal the painful duty of announcing the decease of Professor Petersen, Editor of the *Astronomische Nachrichten*, and Director of the Observatory of Altona.

The absence of his frequent and kind communications, by which the readers of this Journal were as constantly and thoroughly informed of the progress of astronomical investigation and observation in Europe as had been the case during the lifetime of the lamented Schumacher, has doubtless been observed of late, and had already impressed the saddest forebodings upon the mind of the Editor. But long after Professor Petersen's pen was incapable of conveying the assurances of his sympathy and interest, the most cordial and affectionate expressions of these assurances were written at his dictation by another hand, and forwarded with copies of the latest observations and computations which had been sent him.

The mantle of the illustrious Schumacher seemed to have fallen upon Petersen. To him, in conjunction with Professor Hansen, was bequeathed the direction of the priceless *Astronomische Nachrichten,* to which a large portion of many years of his life had already been devoted. To him was confided also the direction of the Observatory of Altona. And he possessed in a signal degree the noble qualities of heart and soul which have endeared the memory of Schumacher to all who knew him. Warm-hearted, unselfish, true, devoted to science, to duty, and to his friends, he has left a void which it will not be easy to fill.

This is neither the place nor the occasion for a description or enumeration of Petersen's labors. Nor do the columns of a Journal devoted to the cold abstractions and stern discussions of a rigorous science invite the expressions of emotion to which heart and pen would gladly give utterance. As a true-hearted man, all loved him; as an earnest, devoted, and laborious votary of science, all must honor him; as a constant friend and zealous helper of our Journal, we offer to his cherished memory the tribute of our gratitude.

G.

Raleigh, N. C., 1854, *March* 9.

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Professor A. C. Petersen.

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THE

ASTRONOMICAL JOURNAL.

No. 69.

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NOTE ON THE SOLUTION OF SOME TRIGONOMETRIC EQUATIONS BY SERIES.

By PROFESSOR W. CHAUVENET,
OF THE U. S. NAVAL ACADEMY.

1. THERE are various trigonometric series which as commonly stated are incomplete, inasmuch as they express but one of the several values of the function of which they are intended to be the development. POINSOT was the first to rectify the developments of sin $m x$ and cos $m x$ in series of ascending powers of sin x or cos x when m is a fraction; which had been erroneously given by both EULER and LAGRANGE in consequence of the neglect of a general term of the form $2 n \pi$ in the investigation. After the memoir of POINSOT, indeed, little remains to be done but to apply the principle in the several cases where needed. The following very simple cases are of so much use in astronomical investigations, that I have thought it worth while to give them a special consideration.

2. It is a well-known theorem, that when m and α are given in the equation,

$$\text{tang}\,\phi = m \,\text{tang}\,\alpha \tag{A}$$

we can find ϕ by the series

$$\phi = \alpha + a \sin 2\alpha + \tfrac{1}{2} a^2 \sin 4\alpha + \tfrac{1}{3} a^3 \sin 6\alpha + \text{\&c.}$$

when $m > 0$; and by the series

$$\phi = -\alpha - \frac{\sin 2\alpha}{a} - \frac{\sin 4\alpha}{2a^2} - \frac{\sin 6\alpha}{3a^3} - \text{\&c.}$$

when $m < 0$; in which

$$a = \frac{m-1}{m+1}.$$

Now for any given values of m and α in (A) we have an infinite number of values of ϕ which satisfy the equation, and which are all contained in the expression

$$\phi = n\pi + \phi_0$$

where ϕ_0 is *any one* of the values which satisfy the equation, and n is any positive or negative integer or zero. In order, therefore, that the series may give all these values, we must write

$$\phi = n\pi + \alpha + a \sin 2\alpha + \tfrac{1}{2} a^2 \sin 4\alpha + \tfrac{1}{3} a^3 \sin 6\alpha + \text{\&c.} \tag{a}$$

$$\phi = n\pi - \alpha - \frac{\sin 2\alpha}{a} - \frac{\sin 4\alpha}{2a^2} - \frac{\sin 6\alpha}{3a^3} - \text{\&c.} \tag{a'}$$

3. On the same principle, the solution of the equation

$$\sin(\alpha + \phi) = m \sin\phi \tag{B}$$

(which is easily reduced to the preceding case) becomes, for $m < 1$,

$$\phi = n\pi - \alpha - m \sin\alpha - \tfrac{1}{2} m^2 \sin 2\alpha - \tfrac{1}{3} m^3 \sin 3\alpha - \text{\&c.} \tag{b}$$

and for $m > 1$,

$$\phi = n\pi + \frac{\sin\alpha}{m} + \frac{\sin 2\alpha}{2m^2} + \frac{\sin 3\alpha}{3m^3} + \text{\&c.} \tag{b'}$$

4. Also the equation

$$\text{tang}\,\phi = \frac{m \sin\alpha}{1 \pm m \cos\alpha}, \tag{C}$$

which is another form of (B), gives, for $m < 1$,

$$\phi = n\pi + m \sin\alpha \mp \tfrac{1}{2} m^2 \sin 2\alpha + \tfrac{1}{3} m^3 \sin 3\alpha \mp \text{\&c.} \tag{c}$$

and for $m > 1$,

$$\phi = n\pi \pm \alpha - \frac{\sin\alpha}{m} \pm \frac{\sin 2\alpha}{2m^2} - \frac{\sin 3\alpha}{3m^3} \pm \text{\&c.} \tag{c'}$$

5. As a simple example of the use of the series thus completed, suppose in a right spherical triangle ABC, right-angled at C, we are to determine b from the equation

$$\text{tang}\, b = \cos A \,\text{tang}\, c.$$

We have in Art. 2,

$$a = \frac{\cos A - 1}{\cos A + 1} = -\text{tang}^2 \tfrac{1}{2} A.$$

If now $A > \frac{\pi}{2}$, $\text{tang}^2 \frac{1}{2} A > 1$, and we must employ the series (a'); moreover, if the triangle is limited by the usual condition that all the parts shall be less than π, we must take $n = 1$; and hence the development is

$$b = \pi - c + \cot^2 \tfrac{1}{2} A \sin 2c - \tfrac{1}{2} \cot^4 \tfrac{1}{2} A \sin 4c + \text{\&c.};$$

and it is plain that the usual form, which would give

$$b = -c + \cot^2 \tfrac{1}{2} A \sin 2c - \text{\&c.},$$

would in this case be inapplicable.

OBSERVATIONS OF FORTUNA,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury. — Corrected for refraction.]

Date	M. T. Washington.	No. of Comp.	Comparison-Star.	⑲ — *		⑲'s apparent	
				Δ α	Δ δ	α	δ
1851.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Feb. 1	10 11 15.2	4	Weisse IX. 1024	+2 27.87	—11 26.36	9 50 4.61	+10 36 35.01
	*	*	*	*	*	*	*
6	9 57 51.0	5	Weisse IX. 1024	—2 19.25	+13 52.57	9 45 17.56	+11 1 53.66

Adopted Mean Place, 1850.0, *of Comparison-Star.*

*	Mag.	α	δ
		h. m s.	° ′ ″
Weisse IX. 1024	8	9 47 23.22	+10 49 9.73

The planet shows like a star of the (10.2) magnitude.

ON THE CORRECTION OF THE ELEMENTS OF CERES.

By ERNEST SCHUBERT.

(*Continued from page* 159.)

1845.

Date.	Observed R.A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h m. s.	s.	s	° ′ ″	″	″	
1845, Aug. 7.8005	22 31 4.93	5.82	+0.89				Washington.
15.5612	28 4.73	5.98	1.25	—25 22 37.4	35.7	+1.7	Greenwich.
20.5417	23 54.56	55.83	1.27	53 29.3	24.1	5.2	"
21.5414	23 3.55	4.73	1.18	25 59 17.0	11.6	5.4	"
26.5247	18 45.29	46.47	1.18	26 26 8.8	2.9	5.9	"
29.5147	16 10.25	11.50	1.25	40 19.9	16.6	3.3	"
30.5113	15 19.20	20.22	1.02	—26 44 42.7	40.3	+2.4	"
31.7212	14 17.27	18.29	1.02				Washington.
Sept. 5.7046	22 10 8.48	9.61	+1.13				"

1846.

Date.	Observed R.A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m s.	s	s	° ′ ″	′ ″	″	
1846, Nov. 3.5758	4 1 50.60	53.12	+2.52	+13 11 29.5	43.7	+14.2	Greenwich.
10.5330	3 55 45.95	48.53	2.58	9 57.8	10 11.5	13.7	Bonn.
11.5297	51 50.26	53.02	2.76	9 50.4	10 1.4	14.0	"
.5193	51 49.31	51.96	2.65	9 49.9	4.3	14.4	Greenwich.
16.5128	50 4.63	7.12	2.49	9 46.4	59.8	13.4	Bonn.
17.5094	49 6.20	8.74	2.54	9 52.4	10 6.0	13.6	"
20.5188	46 8.37	11.05	2.68	10 26.6	41.2	14.6	Greenwich.
Dec. 1.4617	35 32.76	35.55	2.79	16 55.3	17 8.5	13.2	Bonn.
4.4712	3 32 48.87	51.50	+2.63	+13 20 5.6	19.4	+13.8	Greenwich.

For 1848 only two available observations.

1849.

Date.	Observed R.A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.				
1849, June 14.5402	18 42 4.68	3.01	—1.64				Leipsic.
July 11.4187	16 31.32	31.43	[+0.11]	—28° 31′ 33″.4	17″.5	+15″.9	“
12.4153	15 38.13	38.49	[+0.36]	34 14.7	3.0	11.7	“
13.4763	14 46.51	41.56	—1.95	36 58.3	49.2	9.1	Greenwich.
15.1353	18 13 6.54	4.76	—1.78	—28 42 6.2	41′ 51.2	+15.0	Leipsic.

1850.

Date.	Observed R A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.	° ′ ″	′ ″	″	
1850, Sept. 13.5750	0 41 19.70	21.98	+2.28	—12 39 1.5	38 45.4	+16.1	Greenwich.
25.5358	31 49.28	51.44	2.16	13 42 39.7	23.8	15.9	“
30.5192	27 36.35	38.65	2.30	14 4 5.3	3 48.8	16.5	“
Oct. 1.5158	26 45.76	47.94	2.18	7 53.1	38.2	14.9	“
5.5025	23 24.47	26.58	2.11	21 26.8	14.0	12.8	“
7.4959				27 11.4	26 57.5	13.9	“
10.4860	19 20.12	22.26	2.14	34 22.2	7.7	14.5	“
11.4827	0 18 32.58	31.89	+2.31	—14 36 17.2	7.9	+ 9.3	“

1851, 1852.

Date.	Observed R.A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.	° ′ ″	′ ″	″	
1851, Dec. 21.5260	6 50 52.81	51.31	—1.50	+27 41 3.1	40 55.2	— 7.9	Berlin.
1852, Jan. 1.4863	39 38.29	36.95	1.34	28 39 26.2	13.5	12.7	Kremsmünster.
5.4724	35 26.95	25.66	1.29	28 58 15.6	2.2	13.4	“
6.4690	34 24.80	23.40	1.40	29 2 43.4	29.9	13.5	“
8.4621	32 21.83	20.19	1.64	11 17.2	6.5	10.7	“
.4641	32 21.34	20.07	1.27	11 19.5	7.0	12.5	Berlin.
13.4449	6 27 24.90	23.14	—1.76	+29 30 58.7	45.6	—13.1	Kremsmünster.

1853.

Date.	Observed R.A.	Berlin Ephemeris.	Calc. — Obs.	Observed Decl.	Berlin Ephemeris.	Calc. — Obs.	Place of Observation.
	h. m. s.	s.	s.	° ′ ″	′ ″	s.	
1853, April 14.5433	11 48 41.67	38.70	—2.97	—3 35 8.9	31 50.0	+18.9	Berlin.
18.5302	45 26.09	23.25	2.84	25 53.1	32.2	20.9	“
19.5269	44 35.39	32.59	2.80	23 40.1	22.4	17.7	“
29.5032	11 35 44.00	41.19	—2.51	—3 6 39.9	20.0	+19.9	“

NORMAL PLACES.

	① α				① δ			
	From Obs.	From Comp.	$\Delta\alpha\cos\delta$	Log h	From Obs.	From Comp.	$\Delta\delta$	Log h
1832, Oct. 31.5	39° 53′ 50″.31	54′ 12″.85	+22″.45	0.11522	+ 4° 1′ 22″.06	1′ 34″.75	+12″.69	0.11522
1834, Feb. 15.5	155 43 15.45	43 16.57	+ 1.10	0.19897	+27 7 19.67	7 16.29	— 3.38	0.19010
1835, June 10.5	258 24 39.95	24 30.16	— 9.04	0.11522	—22 36 39.58	36 39.27	+ 0.31	0.08805
1836, Sept. 7.5	353 3 8.54	3 46.57	+35.66	0.20748	—20 20 8.11	19 51.07	+17.04	0.23120
1837, Dec. 9.5	76 50 8.07	50 16.72	+ 8.02	0.16111	+22 1 45.04	1 44.86	— 0.18	0.18086
1839, April 6.5	200 55 52.36	55 13.92	—38.08	0.11522	+ 7 53 31.95	53 48.06	+16.11	0.05697
1841, Oct. 12.5	23 49 9.29	49 47.88	+38.43	0.19897	— 5 14 59.68	14 35.99	+23.69	0.17121
1843, Jan. 22.5	127 57 28.69	56 45.12	—37.44	0.15051	+30 45 55.09	45 52.19	— 2.90	0.12764
1844, May 20.5	238 57 0.86	55 58.72	—60.24	0.34950	—14 12 47.15	12 22.50	+24.65	0.28410
1845, Aug. 20.5	335 59 14.97	59 27.36	+11.15	9.97712	—25 53 12.18	53 9.05	+ 3.13	9.88908
1846, Nov. 19.5	56 47 10.86	47 45.96	+34.18	9.97712	+13 10 12.42	10 24.84	+12.42	9.97712
1850, Sept. 24.5	8 10 18.59	10 45.69	+26.34	9.92255	—13 37 44.34	37 32.78	+11.56	9.95155
1852, Dec. 30.5	100 25 58.45	25 49.32	— 8.02	9.92255	+28 29 30.46	29 20.00	—10.46	9.92255
1853, April 20.5	220 56 20.03	55 31.69	—48.26	9.80103	— 3 21 39.25	21 16.41	+22.84	9.80103

EQUATIONS OF CONDITION.

(In order to lessen the coefficients of $\delta\mu$, 1000 $\delta\mu$ was introduced.)

0 = +22″.45	+1.3145 δM	—2.5537 $\delta\varphi$	+1.3754 $\delta\pi$	+0.0678 $\delta\Omega$	—0.2114 δi	+ 0,619.22 $\delta\mu$
0 = + 1.10	+1.7940	—0.0261	+1.5296	—0.0619	—0.6750	+ 1,696.12
0 = — 9.04	+1.4415	+2.8082	+1.5067	+0.0495	+0.0038	+ 2,041.75
0 = +35.66	+1.1933	—1.2333	+1.3705	—0.0333	—0.6498	+ 2,338.51
0 = + 8.02	+1.6087	—2.9371	+1.5194	+0.0531	+0.0068	+ 3,750.99
0 = —38.08	+1.5971	+2.1624	+1.4241	+0.0329	—0.4724	+ 4,506.18
0 = +38.43	+1.2250	—2.0579	+1.3420	+0.0380	—0.4096	+ 4,584.00
0 = —37.44	+1.8558	—1.4088	+1.5993	—0.0524	—0.4338	+ 7,802.96
0 = —60.24	+1.4742	+2.9375	+1.4656	+0.0757	—0.0344	+ 6,909.83
0 = +11.15	+1.2167	—0.0569	+1.4218	—0.0568	—0.6306	+ 6,266.12
0 = +34.18	+1.4514	—2.8843	+1.4381	+0.0755	—0.0481	+ 8,128.48
0 = +26.34	+1.1903	—1.5022	+1.3442	—0.0002	—0.5712	+ 8,350.84
0 = — 8.02	+1.7706	—2.4480	+1.5899	+0.0017	—0.1292	+13,230.60
0 = —48.26	+1.5084	+2.7184	+1.4199	+0.0653	—0.2206	+12,003.30

0 = +12.69	+0.6327	—1.2056	+0.6704	—0.1978	—0.8880	+ 0,277.97
0 = — 3.38	—0.5837	+0.2005	—0.4981	—0.1017	+1.1673	— 0,520.19
0 = + 0.31	—0.3919	—0.7643	—0.4093	+0.2844	+0.0260	— 0,555.14
0 = +17.04	+0.5062	—0.1972	+0.5900	+0.0130	—1.3068	+ 0,925.99
0 = — 0.18	+0.4546	—0.8341	+0.4300	—0.2868	—0.0543	+ 1,058.24
0 = +16.11	—0.8328	—0.9774	—0.7325	+0.1236	+1.3407	— 2,316.57
0 = +23.69	+0.6215	—0.9718	+0.6906	—0.1300	—1.2139	+ 2,300.50
0 = — 2.90	—0.2105	+0.2808	—0.1853	—0.2144	+0.7070	— 0,863.17
0 = +24.65	—0.5955	—1.1773	—0.5868	+0.2615	+0.4301	— 2,779.25
0 = + 3.13	+0.3967	+0.1062	+0.4636	+0.0916	—1.1043	+ 2,018.83
0 = +12.42	+0.5934	—1.1897	+0.5934	—0.2527	—0.4777	+ 3,311.14
0 = +11.56	+0.5801	—0.6191	+0.6618	—0.0577	—1.3558	+ 4,040.16
0 = —10.46	+0.1866	—0.2151	+0.1646	—0.2805	+0.3052	+ 1,403.06
0 = +22.84	—0.7505	—1.2741	—0.6962	+0.1965	+0.9693	— 5,915.09

Corrections.

	δM	$\delta \varphi$	$\delta \pi$	$\delta \Omega$	δi	$\delta \mu$
Combination I.	+90″.08	+11″.22	—94″.82	—7″.59	+7″.51	+0″.0032905
Combination II.	94.91	10.18	—98.19	—9.24	+5.19	+0.001947

RESIDUALS

after the Substitution of the Corrections δ M, etc. in the Equations of Condition.

Combination I.	Combination I.	Combination II.	Combination II.
—18″.25	—11″.67	—14″.36	—7″.59
+18.26	+ 1.34	+21.17	—1.84
+15.82	— 8.13	+11.97	—8.04
+ 2.44	— 2.38	+ 3.27	+0.04
—23.20	— 4.11	—11.53	—3.31
+ 6.03	+ 1.09	+ 1.69	+0.35
+10.16	+ 2.75	+ 8.43	+4.35
—14.90	+ 2.79	—19.26	+2.44
—11.56	+ 7.55	—21.75	+8.16
+ 1.61	— 6.25	— 4.10	—6.31
+22.03	+ 5.49	+16.25	+4.68
+12.44	— 3.32	+ 5.33	—3.30
+15.83	— 2.64	+ 4.06	—4.20
+20.80	— 7.17	+ 4.76	—1.37
	Absolute Sum 257.01		Absolute Sum 203.61

	M	π	Ω	i	φ	μ
1831, July 23.0, M. T. Berlin,	159° 25′ 3″.99	147° 38′ 46″.50	80° 53′ 14″.04	10° 36′ 58″.84	4° 21′ 5″.69	769″.28942
Corrections (Combination II.),	+ 1 34.91	— 1 38.19	— 9.24	+ 5.19	+ 10.18	+0.00195
Perturb. by ♃ (1831, July 23 – 1854, Jan. 0),	— 1 20 48.55	+ 59 26.74	— 20 2.82	+ 4.40	+ 22.51	+0.31738
$\iint \frac{\delta \mu}{dt} \delta t^2$,	+ 3 35 20.96					
8197 × 769″.29137,	+311 38 1.36					
Precession,		+ 18 47.34	+ 18 47.34			
Cor. for the secular variation of the obliquity,		+ 1.02	— 58.53	+ 0.11		
Reduced to the meridian of Washington,	+ 3 12.41					

1854, Jan. 0, M. T. Washington.

$M =$ 113° 22′ 25″.08
π 148 55 23.41
Ω 80 50 50.79
i 10 37 8.54
φ 4 21 38.41
μ 769″.63875

EPHEMERIS OF FLORA, FOR 1855.

BY PROFESSOR AUGUSTUS W. SMITH,
OF THE WESLEYAN UNIVERSITY.

[Communicated by Lieut. CHARLES HENRY DAVIS, Superintendent Nautical Almanac.]

THE elements from which this ephemeris was computed were obtained from those published in the British Nautical Almanac, for the epoch 1852, March 24, by the addition of the perturbations by *Mercury*, *Venus*, *Earth*, *Mars*, *Jupiter*, and *Saturn* to the beginning of the year 1855, and by *Mars*, *Jupiter*, and *Saturn* through the year 1855, at intervals of four days.

Elements at Opposition.

1855, Feb. 21, 0h. M. T. Washington.

$M = 102^\circ\ 32'\ 25''.41$
$\pi \quad 33\ 12\ 16.45$
$\Omega \quad 110\ 20\ 35.30$
$i \quad 5\ 53\ 15.00$
$\varphi \quad 8\ 59\ 51.36$
$\mu \quad 1085.94014$
$\text{Log}\ a \quad 0.34228005$

Ephemeris.

Washington M. T.	⑧ α	⑧ δ	Log △	Log r
	h. m. s.	° ′ ″		
1855, Jan. 0	10 52 57.8	+11 17 10.2	0.1993685	0.3495772
4	10 53 41.9	11 29 10.9	.1893583	.3509502
8	10 53 55.6	11 44 35.8	.1796409	.3523118
12	10 53 37.9	12 3 25.6	.1703201	.3536602
16	10 52 48.4	12 25 31.5	.1615267	.3549966
20	10 51 27.2	12 50 51.3	.1533911	.3563194
24	10 49 35.0	13 18 58.1	.1460536	.3576290
28	10 47 13.4	13 49 30.8	.1396493	.3589242
Feb. 1	10 44 24.6	14 22 0.1	.1343014	.3602056
5	10 41 11.26	14 55 52.88	.1301243	0.3614724
6	10 40 19.48	15 4 29.95	.1292757	
7	10 39 26.48	15 13 9.33	.1285085	
8	10 38 32.24	15 21 50.42	.1278237	
9	10 37 36.83	15 30 32.57	.1272233	0.3627244
10	10 36 40.38	15 39 15.13	.1267082	
11	10 35 42.96	15 47 57.43	.1262796	
12	10 34 44.63	15 56 38.81	.1259385	
13	10 33 45.47	16 5 18.55	.1256858	0.3639616
14	10 32 45.58	16 13 55.98	.1255223	
15	10 31 45.04	16 22 30.47	.1254487	
16	10 30 43.92	16 31 1.32	.1254653	
17	10 29 42.32	16 39 27.90	.1255726	0.3651836
18	10 28 40.32	16 47 49.55	.1257714	
19	10 27 38.03	16 56 5.62	.1260602	
20	10 26 35.57	17 4 15.48	.1264396	
21	10 25 32.92	17 12 18.53	.1269087	0.3663900
22	10 24 30.30	17 20 14.20	.1274676	
23	10 23 27.75	17 28 1.92	.1281154	
24	10 22 25.36	17 35 41.18	.1288520	
25	10 21 23.20	17 43 11.51	.1296757	0.3675804
26	10 20 21.35	17 50 32.46	.1305860	
27	10 19 19.90	17 57 43.56	.1315825	
28	10 18 18.95	18 4 44.35	.1326634	
March 1	10 17 18.59	18 11 31.40	.1338275	0.3687554
2	10 16 18.88	18 18 13.33	.1350730	
3	10 15 19.90	18 24 40.85	.1363990	
4	10 14 21.73	18 30 56.67	.1378030	
5	10 13 24.45	18 37 0.54	.1392849	0.3699140
6	10 12 28.13	18 42 52.20	.1408420	
7	10 11 32.83	18 48 31.44	.1424726	
8	10 10 38.61	18 53 58.04	.1441761	
9	10 9 45.54	18 59 11.78	.1459508	0.3710562
13	10 6 25.9	19 17 55.3	.1537204	0.3721818
17	10 3 29.3	+19 33 3.5	0.1624688	0.3732906

Washington M. T.	⑧ α	⑧ δ	Log △	Log r
	h. m. s.	° ′ ″		
1855, March 21	10 0 58.6	+19 44 33.9	0.1720627	0.3743824
25	9 58 55.8	19 52 29.4	.1823633	.3754574
29	9 57 22.1	19 56 57.4	.1932359	.3765152
April 2	9 56 17.9	19 58 8.1	.2045514	.3775554
6	9 55 42.1	19 56 12.8	.2161976	.3785784
10	9 55 37.1	19 51 22.8	.2280820	.3795802
14	9 55 59.0	19 43 49.0	.2401197	.3805712
18	9 56 47.9	19 33 41.9	.2522267	.3815404
22	9 58 2.6	19 21 11.8	.2643266	.3824920
26	9 59 41.5	19 6 29.0	.2763653	.3834256
30	10 1 43.0	18 49 43.3	.2882894	.3843408
May 4	10 4 5.6	18 31 3.4	.3000495	.3852370
8	10 6 47.5	18 10 36.9	.3116309	.3861158
12	10 9 47.5	17 48 30.5	.3230024	.3869758
16	10 13 4.1	17 24 49.9	.3341400	.3878166
20	10 16 36.8	16 59 40.6	.3450266	.3886408
24	10 20 23.4	16 33 8.3	.3556394	.3894458
28	10 24 22.8	16 5 18.7	.3659688	.3902308
June 1	10 28 34.1	15 36 16.8	.3760094	.3909976
5	10 32 56.0	15 6 6.7	.3857599	.3917454
9	10 37 27.9	14 34 51.6	.3952198	.3924752
13	10 42 9.0	14 2 34.9	.4043855	.3931850
17	10 46 58.5	13 29 20.0	.4132495	.3938760
21	10 51 55.8	12 55 10.4	.4218111	.3945460
25	10 57 0.1	12 20 10.1	.4300719	.3952012
29	11 2 10.6	11 44 22.8	.4380326	.3958350
July 3	11 7 26.9	11 7 51.8	.4456992	.3964500
7	11 12 48.7	10 30 39.6	.4530751	.3970442
11	11 18 15.6	9 52 48.4	.4601609	.3976220
15	11 23 47.3	9 14 20.9	.4669580	.3981794
19	11 29 23.3	8 35 20.5	.4734680	.3987174
23	11 35 3.4	7 55 50.7	.4796891	.3992360
27	11 40 47.1	7 15 54.8	.4856278	.3997352
31	11 46 34.3	6 35 35.6	.4912888	.4002152
Aug. 4	11 52 24.9	5 45 55.5	.4966751	.4006760
8	11 58 18.6	5 13 56.7	.5017902	.4011176
12	12 4 15.5	4 32 41.9	.5066336	.4015396
16	12 10 15.4	3 51 14.0	.5112040	.4019426
20	12 16 18.0	3 9 36.5	.5155016	.4023252
24	12 22 23.2	2 27 52.8	.5195313	.4026890
28	12 28 30.9	1 46 5.8	.5232976	.4030336
Sept. 1	12 34 41.1	1 4 17.7	.5268030	.4033584
5	12 40 53.8	+ 0 22 30.9	.5299434	.4036640
9	12 47 9.0	— 0 19 11.8	.5330256	.4039496
13	12 53 26.5	1 0 47.5	.5357421	.4042164
17	12 59 46.4	1 42 12.5	.5381966	.4044632
21	13 6 8.5	2 23 23.6	.5403883	.4046912
25	13 12 32.7	3 4 17.8	.5423199	.4048990
29	13 18 59.1	3 44 52.7	.5439936	.4050882
Oct. 3	13 25 27.6	4 25 5.8	.5454086	.4052592
7	13 31 58.4	5 4 54.3	.5465648	.4054074
11	13 38 31.2	5 44 15.0	.5474559	.4055398
15	13 45 6.1	6 23 4.7	.5480822	.4056486
19	13 51 42.8	7 1 20.2	.5484423	.4057400
23	13 58 21.4	7 38 58.2	.5485105	.4058166
27	14 5 1.7	8 15 56.1	.5483759	.4058646
31	14 11 43.7	8 52 11.6	.5479481	.4058974
Nov. 4	14 18 27.5	9 27 42.2	.5472466	.4059110
8	14 25 12.9	10 2 25.0	.5462860	.4059046
12	14 31 59.6	10 36 16.4	.5450160	.4058792
16	14 38 47.6	—11 9 13.6	0.5435317	0.4058342

Washington M. T.	⑧ α	⑧ δ	Log △	Log r
	h. m. s.	° ′ ″		
1855, Nov. 20	14 45 36.6	—11 41 13.9	0.5417440	0.4057696
24	14 52 26.4	12 12 15.0	.5396820	.4056854
28	14 59 17.0	12 42 15.4	.5373455	.4055816
Dec. 2	15 6 8.2	13 11 12.9	.5347303	.4054590
6	15 12 59.8	13 39 4.8	.5318288	.4053166
10	15 19 51.4	14 5 48.9	.5286416	.4051542
14	15 26 42.7	14 31 22.9	.5251667	.4049728
18	15 33 33.4	14 55 44.9	.5214048	.4047714
22	15 40 23.1	15 18 53.9	.5173530	.4045508
26	15 47 11.6	15 40 49.3	.5130097	.4043108
30	15 53 58.9	—16 1 29.5	0.5083735	0.4040514

OBSERVATIONS OF MELPOMENE,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury. — Corrected for refraction.]

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑱ — *		⑱'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1854, Jan. 4	10 2 21.57	5	Weisse VIII. 1367	+1 53.15	+ 0 57.00	8 54 58.68	+ 9 7 57.95
23	9 48 54.45	5	" 999	—2 0.81	— 3 8.24	8 36 46.27	11 25 49.12
	9 51 56.69	4	1041 Σ. Cat. Gen.	—2 27.15	—15 43.13	8 36 46.22	11 25 46.20
24	7 29 48.05	2	Weisse VIII. 999	—2 57.65	+ 4 30.74	8 35 49.45	11 33 28.14
		2	1044 Σ. Cat. Gen.	—3 23.60	— 8 8.00	8 35 49.77	11 33 21.26
27	8 25 53.01	20	Weisse VIII. 828	+0 45.31	— 4 0.17	8 32 37.71	11 59 28.83
28	9 51 19.76	6	" 828	—0 20.36	+ 5 11.61	8 31 32.02	12 8 40.48
Feb. 1	8 39 29.79	12	" 736	—0 58.30	+21 12.26	8 27 28.84	12 42 41.62
6	9 10 23.23	10	" 618	—1 32.34	+ 8 16.84	8 22 35.38	13 25 51.13
21	7 40 22.54	8	B. Z. 273, 108	—2 45.63	+11 15.37	8 11 1.08	+15 24 59.92

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse VIII. 1367	7	8 52 52.35	+ 9 7 53.43	Weisse's Catalogue.
" 999	9	8 38 33.35	11 29 48.10	" "
Struve's Cat. Gen.	8.9	8 38 59.61	11 42 20.19	Struve's Catalogue Generalis.
Weisse VIII. 828	8	8 31 38.53	12 4 18.02	Weisse's Catalogue.
" 736	9	8 28 13.20	12 22 17.63	" "
" 618	8	8 23 53.64	13 18 21.41	" "
B. Z. 273, 108	8	8 13 32.23	+15 14 28.37	Bessel's Zones.

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SUGGESTIONS RELATIVE TO THE OBSERVATION OF THE SOLAR ECLIPSE OF MAY 26, 1854.

By STEPHEN ALEXANDER, LL. D.,
PROFESSOR OF MATHEMATICS AND ASTRONOMY IN THE COLLEGE OF NEW JERSEY.

Read before the American Association for the Advancement of Science, and referred for immediate publication.

The Committee appointed by the American Association to make arrangements for observing the eclipse of May 26 recommended that Professor ALEXANDER be requested to furnish his paper for immediate publication, and that the Standing Committee of the Association be authorized to print the paper and circulate it among observers. This recommendation was adopted by the Association.

THE title of this paper is sufficiently indicative of its object. The phenomena to which it relates will be considered in their natural order; but, that the notice of them may not afterward be interrupted, it may be well enough to describe at the outset an arrangement of screen-glasses which may be found to be convenient when a ready adaptation, and especially a rapid change, of them is desired.

To effect the objects last mentioned, several screen-glasses of various colors might be arranged in a circular frame movable about a central pivot, so that each screen-glass might, in its turn, be brought in front of the eye-piece of the telescope, at the pleasure of the observer.

The rotary motion might be rendered more steady by the pressure of a small spring with a tooth falling into a shallow dent in the revolving frame; as is the case in the adjustment of dark glasses made use of in some sextants. It would, moreover, seem to be advisable that the succession of tints of the several screen-glasses should be such, that the eye would not be too much "blinked" or rendered insensible by a sudden change of one for another; the order being somewhat like the following: *white*, *yellow*, *orange*, *red*, *violet*, *blue*, and (if there be room for them) then *green* and *greenish-yellow;* to come back, in the circuit, to *white* again. The white tint of sun-light is preserved when the view is through Dr. MASKELYNE's screen of liquid ink, or the like effect may be obtained by a suitable combination of screens of different colors, such as, for instance, *violet* and *green glasses*, the number of violet glasses being in excess. The singularly tinted glass which goes by the name of *London smoke* is, however, perhaps the best of all for presenting a white image of the sun, as by it all colors are transmitted, although with a diminished intensity.[†]

Proceeding next with the phenomena to be observed, those demanding special attention will be found marked with an asterisk. In thus distinguishing some of them, the author has been governed by the unanimous opinion of the Committee of the American Association as expressed at their meeting; namely, that the *times* of the beginning, end, &c. ought to be carefully noted at places whose geographical positions are *well* determined; but that, at other places, *the observation of the physical phenomena should be carefully attended to*, even if the precise time of their occurrence should thereby fail to be noted.

Having regard, as already intimated, to the natural order of sequence of the phenomena, we have,—

(*A.*) *Phenomena observable before the Beginning of the Eclipse.*

(1.)* The idea suggested by Mr. DELISLE, that the border of the moon might be seen when off the sun, seems to have derived additional confirmation from the observations made in Europe during the total eclipse of 1851.

The moon seems to have been in part visible under such circumstances, or rather her outline to have been seen, because

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[†] My attention was called to this highly suitable material by Professor JOHN F. FRAZER, in the course of the deliberations of the committee on this eclipse. It has itself some variety of tint, but as many screens of it as may be requisite may be combined; the aperture of the object-glass being moreover reduced if necessary.

the luminous substance surrounding the sun is then partially hidden.

Now, as white is the complementary color to black, it would seem that the approach of the moon before the first contact might be best discerned, if visible at all, through a screen showing a *white* sun; i. e. one of those already described, and especially that last mentioned. It is desirable that the white tint under such circumstances should be very perfect, as otherwise the complementary and accidental color would seemingly overspread the region beyond the sun's limb. If, however, any such screen should prove after all to be unserviceable in showing where the field is thus obscured by the interposition of the moon, a screen of any of the other colors secured in the movable frame might at once be introduced, and the position of the moon's limb perhaps be recognized, through the colored glass thus found to be best adapted to the purpose.

(*B.*) *At the Beginning of the Eclipse.*

(2.)* Prominent points indenting the sun's disc in advance of the moon's general outline. These might very probably be visible through a screen-glass of some one special color (*red* perhaps), and not discernible through another of a different tint. The difference, if any, would require the notice of *two* or *more* observers, severally furnished with different-colored screen-glasses.

(3.)* "Dark" lines or "indentations," analogous to Baily's (?). (Professor W. R. Johnson saw them at Philadelphia, in 1838, for eight seconds.)

It would be better also to have more observers than one to note these, the observers being severally furnished with screen-glasses as for the observation of phenomenon (2).

(3′.) The time of the unequivocal contact of the limbs.

(*C.*) *As the Eclipse progresses.*

(4.) The bending or distortion of the cusps of the uneclipsed portion of the sun, as the moon advances.

(5.) An agitation of the edge of the moon's disc. (Is reported by some observers; but may have been due to variable refraction of those observers' atmosphere.)

(6.) Corruscations across the moon's disc.

(7.)* An illuminated band bordering the moon's disc, and distinguished from the rest of the uneclipsed portion of the sun by its seemingly greater intensity.

(8.)* Special phenomena accompanying the eclipse of a solar spot. (Rev. Mr. Dawes of Ormskirk has recorded and represented a remarkable instance of the illumination of a solar spot, and Professor L. R. Gibbes of Charleston, S. C. observed an apparent repulsion of a solar spot in 1846.)

(8′.)* The polarization of light under these circumstances.

(9.) Luminous projections on the moon's disc.

(10.)* (Analogous to (1).) Projection of the moon's disc beyond that of the sun, in this more advanced state of the eclipse.

(11.) Color of the moon's disc. This may be found not to be independent of the color of the screen-glass. The latter should therefore be specified (in the account of any observation), for that as well as many other reasons.

(*D.*) *Immediately previous to the Formation of the Ring.*

An appearance like a twilight between the cusps. With regard to this should be noticed: —

(*a.*)* The time of its first appearance.

(*b.*)* Its extent, in the direction of both its polar coördinates; viz. along the circumference of the moon's disc, and in the direction of the moon's radius outward.

(*c.*)* The color of the light, if invariable; or

(*c′.*)* Any changes in its intensity or its color.

(*d.*)* Its apparent motion, if any, along the edge of the moon's disc.

(*e.*)* The polarization of this light, if discoverable.

(*f.*)* Whether the light be found to undergo any special change just as the ring is about to form.

(*g.*)* The actual intensity of the light; which may be determined in some measure by the depth of tint of the screen-glass through which it is discernible: as was done by Bessel in 1836.†

(*E.*) *At the Formation of the Ring.*

(*a.*)* The form and changes of form of the cusps. These not unfrequently have been found to be united rapidly by a serrated bright edge, assuming sometimes (and later) the appearance of a row of beads.

(*b.*)* The apparent motion of such portions of the sun's disc along the moon's edge.

(*c.*)* If also attainable, the time of commencement and exact duration of such appearances.

(*d.*)* Their color and its changes, if any.

(*e.*)* The time of the complete formation of the ring.

(*f.*)* *The dark lines* of Professor Baily. These should be very carefully sought for; the rather, as this eclipse may be regarded as a return of that of 1836. The several changes of those dark lines should also be noted.

(*g.*)* Whether the ring when completely formed is any broader or any narrower than the beads were.

(*F.*) *While the Ring endures.*

(*a.*) Project the shadow of a ball upon a suitable screen, and observe not only its annular form, but also whether it be found to exhibit any colored fringes, and if so, then their variety and extent.

(*b.*) Having obtained a solar spectrum, observe the character and disposition of its colors, and also *its dark lines*.

(*c.*) Any special changes of outline or beams of light indenting the moon, as she recedes from or approaches the sun's edge. (To Professor Baily the moon's edge appeared more convex on the side on which the ring was, for the moment, the narrower.)

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† (*e*) and (*g*) may be more readily determined at stations near to the limit of the annular eclipse, where the moon's edge will appear nearly in contact with that of the sun for some time.

(*d.*) The color of the moon's disc. This may, as before intimated, not be independent of that of the screen-glass. (To Professor Baily, as seen through a red glass in 1836, the moon appeared of a purple tint during the existence of the ring.)

(*e.*) The angular breadth of the ring, determined by a micrometer.[†]

(*f.*) The moon's diameter.[†]

(*G.*) *At the Rupture of the Ring.*

The same phenomena as at the formation; though in the inverse order.

(*H.*) *Immediately after the Rupture of the Ring.*

As at the corresponding period before the formation; but also in the inverse order.

(*I.*) *Between the Rupture of the Ring and the End of the Eclipse.*

As in the analogous period after the beginning.

(*K.*) *At the End of the Eclipse.*

Time of the last unequivocal contact.

(*L.*) *Continued Adhesions, &c.*

As at the analogous period preceding the first decided contact.

(*M.*) *After the End of the Eclipse.*

Same appearance, (1), to be sought for as before the beginning.

Miscellaneous Observations at Various Times during the Eclipse.

1.* Temperature of the atmosphere in the sun and in the shade.
2. Photometric observations (?).
3. Change in the dew-point and deposition of dew.
4. Polarization of the light of the atmosphere.
5. Polarization of the heat of the same.
6. The peculiar tint of the sky.
7. The course, as well as variable force, of the wind.
8. Change, if any, of magnetic intensity (?).

When the number of phenomena, all to be noted in a very short time, was very great, only the more indispensable observations have been marked with the asterisk, though several of the others would be of interest if they could be obtained, and they might perhaps be completed, if several observers were collected at one station.

For the purpose of a more ready reference, the various particulars which have now been specified will here be concisely recapitulated.

TABULAR VIEW.

(1.)* Observation of the edge of the moon's disc when off the sun.

(2.)* Indentations of prominent points
(3.)* Special roughness or dark lines } *At the Beginning.*
(3′.) First unequivocal contact
(4.)* Distortion of the cusps.
(5.) Agitation at the edge of the moon's disc (?).
(6.) Corruscations across the moon's disc.
(7.)* An illuminated band bordering the moon's disc.
(8.)* *Effects on solar spots.*
(8′.) Polarization of light at solar spots.
(9.) Luminous projections on the moon's disc.
(10.)* Analogous to (1), projection of the moon's disc beyond that of the sun.
(11.) Color of the moon's disc.

Previous to the Formation of the Ring.

The light between the cusps.
(*a.*)* The time of its first appearance.
(*b.*)* Its extent in both length and breadth.
(*c.*)* Its color, if invariable; or
(*c′.*)* Changes in the light's intensity or its color.
(*d.*)* Its apparent motion, if any, along the edge of the moon's disc.
(*e.*)* Its polarization.
(*f.*) Its special changes just before the formation of the ring.
(*g.*) Its intensity as indicated by the depth of tint of the screen-glass traversed by it.

At the Formation of the Ring.

Serrated appearances or beads.
(*a.*)* The form and changes of form of the cusps
(*b.*)* Their motion along the moon's edge.
(*c.*) Time of their commencement and their exact duration.
(*d.*)* Their color, and its changes.

(*e.*) Time of complete formation of the ring.

(*f.*)* *The dark lines of* Professor Baily: same particulars to be noted with regard to them as those specified in the case of the beads.

(*g.*) Whether the ring when completely formed is found to be any broader or any narrower than the beads.

While the Ring endures.

(*a.*) The projected shadow of a ball, and its colors, if any, and their extent.

(*b.*) The extent and variety of the colors of the solar spectrum, and their dark lines.

(*c.*) The special changes of outline of the moon by encroachment of light or by distortion of the disc.

(*d.*) The color of the moon's disc.

(*e.*) The angular breadth of the ring.

(*f.*) The moon's diameter.

[†] With a view to determine the extent of inflection, and also that of irradiation if the sun's diameter be measured, which need not be done at that moment.

At the Rupture of the Ring.
Immediately after the Rupture of the Ring.
Between the Rupture and the End of the Eclipse.
At the end of the Eclipse, and immediately thereafter ; and
After the end.

As at the respectively analogous periods in the former part of the eclipse, but in an inverse order in every case.

Miscellaneous Observations at Various Times.

1. Temperature in sun and shade.
2. Photometric observations (?).
3. Change of dew-point and deposition of dew.
4. Polarization of the light of the atmosphere.
5. Polarization of its heat.
6. Tint of the sky.
7. Course and variable force of the wind.
8. Change, if any, of magnetic intensity (?).

CORRECTION OF THE ELEMENTS OF EUNOMIA AND THALIA.

By ERNEST SCHUBERT.

[Report to Lieut. Charles Henry Davis, Superintendent Nautical Almanac.]

EUNOMIA.

The work on *Eunomia* was commenced with an approximate set of elements by Mr. G. Rümker, published in No. 859 of the *Astronomische Nachrichten.* They are, —

1852, Jan. 0.0, M. T. Berlin.

$M = 314^\circ\ 21'\ 55''.5$
$\pi \quad 27\ 53\ 58.3$
$\Omega \quad 293\ 54\ 30.0$
$i \quad 11\ 43\ 59.6$
$\varphi \quad 10\ 49\ 33.4$
$\mu \quad 825''.5813$
Log a 0.422165
“ μ 2.916760

From these elements an ephemeris for the first series of observations was computed, and an ephemeris interpolated from 2 to 2 days, for the purpose of comparing observations and thus forming normal places. All the Naples observations I have excluded from the mean for the first normal place, on account of their not harmonizing well with the observations made at other places, as will be seen in the list. For the second normal place, I used only Washington observations, excepting one Cambridge (England) observation. The Washington observations harmonize very well with one another, and also with the Cambridge observation after augmenting the right-ascension of the latter by 1^{s} in time, in which I considered myself authorized, as the Cambridge observations always deserve great credit. The declination is in perfect harmony. An error of 1^{s} or 10^{s} frequently occurs in the reductions, and the change by 1^{s} in time or 15′ in arc makes the right-ascension agree very well with the Washington observations, and perfectly with the mean.

The third normal place, at the beginning of the second series of observations, is calculated twice. In the first formation, I employed a roughly approximate ephemeris by Mr. G. Rümker, published in No. 816 of the *Astr. Nachr.* The comparison of the observations with this gave a difference in right-ascension of about 3′, and a considerable variation of the discrepancies in right-ascension as well as in declination. This variation was properly taken into account, and the normal place, referred to the true equinox, obtained. But partly because I was rather distrustful of the obtained place, and partly to see what the result would be, I computed a short ephemeris from the above elements and compared the selected observations with this also. The results obtained in these two ways are almost identical, but the second determination was preferred in the farther calculation. This shows that it matters very little, in the formation of normal places, how great the approximation to the truth in the ephemeris is, provided one and the same principle is throughout adhered to, and the variation of the discrepancies properly taken into account.

After the comparison of the Berlin observation on July 13, I was not satisfied with the result, and distrustful of the observation. I therefore requested the observer, Mr. Bruhns, to examine the reduction, and he found a mistake in the time of observation ; it must be $12^{h}\ 37^{m}\ 10^{s}.1$, instead of $12^{h}\ 24^{m}\ 42^{s}.1$.

Having thus obtained three normal places, which in my opinion deserve great confidence, I proceeded to the computation of an orbit from them, as will be found from p. 17 to p. 25. The elements are, —

1852, Jan. 0.0, M. T. Berlin.

$M = 314^\circ\ 30'\ 30''.8$ For Washington, $M = 314^\circ\ 33'\ 57''.9$
$\pi \quad 27\ 45\ 42.7$ } Mean Eq. epoch.
$\Omega \quad 293\ 51\ 20.3$ }
$i \quad 11\ 43\ 58.9$
$\varphi \quad 10\ 50\ 41.9$
Log a 0.422410
“ μ 2.916347
$\mu \quad 824''.7962$

These are now the elements to be corrected later by the method of least squares. For this purpose, and therefore for that of forming more normal places, an ephemeris for the second period of observations was computed from them.

My next work on *Eunomia* will now be, the computation of the perturbations with the above elements since the discovery up to the third period of observations, and an ephemeris for this period, in which the perturbations are taken into account.

THALIA.

For the computation of an orbit, I found three suitable observations made at Berlin, which were carefully examined with respect to copying and printing, lest an orbit might be computed that finally would prove good for nothing; this circumspection (if possible) is not to be neglected in the case of three single observations. The calculation was carried through, as if the elements were entirely unknown yet; therefore the observations could not be corrected for aberration and parallax in advance, P and Q for the hypotheses could not be computed more approximately, and therefore a good many hypotheses were to be made, the interval $t''-t$ being considerable (134.99... days) too. Twelve pages contain the whole and complete calculation of the orbit. Not a single small correction is neglected, and the arrangement of the computation is such that one can follow it step for step easily through. The finally obtained elements are, —

1853, Jan. 0.0, M. T. Berlin.

$$\begin{array}{lrl}
M = & 326^\circ\;53'\;32''.9 & \text{For Washington,} = 326^\circ\;56'\;58''.4 \\
\pi & 122\;\;33\;\;40.9 & \left.\begin{array}{l} \\ \\ \end{array}\right\} \text{Mean Eq. epoch.} \\
\Omega & 67\;\;52\;\;42.2 & \\
i & 10\;\;13\;\;29.7 & \\
\varphi & 14\;\;\;5\;\;57.0 & \\
\text{Log}\; a & 0.424883 & \\
\text{"}\;\;\mu & 2.912683 & \\
\mu & 817''.8680 &
\end{array}$$

With this ephemeris, I shall now compare the observations of the first period, form three normal places, and compute a more approximate orbit.

OBSERVATIONS OF FORTUNA AND LUTETIA,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury. — Corrected for refraction.]

FORTUNA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑲ — *		⑲'s apparent	
				Δα	Δδ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1854, Feb. 1	10 11 15.13	4	Weisse IX. 1024	+2 27.87	—11 26.36	9 50 4.61	+10 36 35.01
2	9 31 26.10	4	" 1024	+1 33.12	— 6 37.77	9 49 9.87	10 41 23.56
6	9 57 51.03	5	" 998	—0 53.84	+ 5 16.66	9 45 17.32	11 1 54.93
		5	" 1024	—2 19.26	+13 52.57	9 45 17.56	11 1 53.66
10	9 23 4.98	4	" 871	+1 29.83	+19 16.74	9 41 22.70	11 22 44.59
		4	" 887	+0 21.16	+ 8 43.40	9 41(23.69)	11 22 44.13
21	9 23 28.02	7	" 579	+4 18.17	+ 9 39.09	9 30 47.89	12 20 6.04
27	8 10 49.14	20	" 563	—0 8.65	+ 4 54.15	9 25 38.52	+12 48 51.96

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

	*	Mag.	α	δ	Authority.
			h. m. s.	° ′ ″	
	Weisse IX. 1024	8	9 47 23.22	+10 49 9.73	Weisse's Catalogue.
	" 998	8	9 45 57.57	10 57 46.68	" "
	" 871	8	9 39 39.27	11 4 36.05	" "
(1)	" 887	9	9 40 48.92	11 15 9.20	Washington Mural; Prof. Yarnall.
	" 579	9	9 26 15.88	12 11 41.27	Weisse's Catalogue.
	" 563	9	9 25 33.26	+12 45 2.03	" "

(1) The mean place of this star is corrected + 30 seconds from the place in Weisse.

LUTETIA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉑ — * Δα	㉑ — * Δδ	㉑'s apparent α	㉑'s apparent δ
1854.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Feb. 21	10 15 23.15	5	B. Z. 280, 51	+1 3.74	— 7 46.76	10 0 49.87	+16 51 28.08
23	10 9 51.73	3	" 280, 51	—0 50.93	+ 2 33.18	9 58 55.22	17 1 48.24
27	9 9 10.32	6	" 280, 49	—2 8.21	+10 46.25	9 55 12.52	17 21 16.23
Mar. 5	9 25 42.75	4	" 274, 153	+0 52.26	+ 2 3.41	9 49 52.70	17 46 59.31
12	8 41 53.18	4	" 274, 148	—0 55.62	+ 5 27.15	9 44 26.11	18 10 51.76
		4	Rümker 2981	—0 59.15	— 9 38.66	9 44 25.84	18 10 46.94
18	9 9 21.96	3	B. Z. 274, 137	—0 31.50	—18 14.68	9 40 31.67	18 25 45.11
19	7 46 46.58	14	"	—1 3.68	—16 25.92	9 39 59.51	+18 27 33.11

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 280, 51	8	9 59 32.10	+17 0 26.70	Bessel's Zones.
" 280, 49	9	9 57 6.65	17 11 31.96	"
" 274, 153	9	9 48 46.29	17 46 5.83	"
" 274, 148	9	9 45 7.30	18 6 32.33	"
Rümker 2981	9	9 45 11.36	18 21 33.29	Rümker's Catalogue, and Bessel's Zones.
B. Z. 274, 137	7.8	9 40 47.62	+18 45 6.03	Bessel's Zones.

OBSERVATIONS OF ASTEROIDS, MADE AT THE HAMBURG OBSERVATORY.

[Communicated by Professor Charles Rümker.]

EUTERPE.

Date.	Hamburg M. T.	㉗ App. α	Log. Factor of Parallax.	㉗ App. δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars. α	Apparent Places of Comparison-Stars. δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
1853, Nov. 15	10 3 49.0	48 5 57.0	9.3710*n*	+15 42 46.6	9.7945	6	3 6 56.195	+15 42 39.0
27	7 31 21.8	45 15 5.9	9.6467*n*	15 10 4.9	9.8233	6	3 2 18.835 3 3 11.042	15 25 47.1 15 9 17.0
27	10 34 1.8	45 13 31.9		15 9 55.3	9.7930	M.C.		
28	7 53 45.3	45 2 9.9	9.5900*n*	15 7 52.0	9.8537	6	3 2 18.839 3 3 11.041	15 25 47.1 15 9 17.0
28	10 29 15.4	45 0 54.1		15 7 37.7	9.7934	M.C.		
30	10 18 47.2	44 36 41.8		15 3 33.6	9.7940	M.C.		
Dec. 1	7 22 52.9	44 26 42.4	9.6262*n*	15 2 0.1	9.8210	3	2 56 33.315	15 17 18.1
2	10 10 24.9	44 14 4.2		14 59 59.0	9.7946	M.C.		
10	9 34 11.7	43 2 23.3		14 51 17.9	9.7960	M.C.		
11	6 31 12.5	42 56 40.9	9.6384*n*	14 50 56.3	9.8242	8	2 50 34.938 2 52 49.625	14 34 3.8 14 27 7.2
13	9 21 10.4	42 43 57.4		14 50 33.9	9.7962	M.C.		
14	9 16 54.4	42 38 54.7		14 50 40.0	9.7960	M.C.		
22	8 44 7.0	42 18 19.9		14 57 5.5	9.7951	M.C.		
25	8 32 26.4	42 20 37.4		15 2 18.1	9.7942	M.C.		
1854, Jan. 20	7 26 45.4	45 57 41.8	8.7795	16 40 5.6	9.7770	10	3 2 51.586 3 4 3.020	16 44 44.0 16 44 47.0
22	10 59 18.0	46 30 10.8	9.7319	16 51 31.2	9.8379	6	3 4 2.994	16 44 46.9
24	7 32 8.5	46 59 35.6	9.0258	17 1 36.2	9.7712	15	3 8 57.947	17 1 56.8
Feb. 2	6 48 19.3	49 41 1.3		17 53 43.8	9.7636	M.C.		
2	7 6 35.8	49 41 41.1	9.0172	17 53 48.0	9.7702		3 18 42.731	18 14 34.7
4	8 50 27.9	50 23 11.0	9.5761	18 6 50.4	9.7884	19	3 21 26.821	18 14 2.1
16	7 39 9.2	51 50 18.4	9.4487	+19 20 19.6	9.7637	8	3 35 4.363 3 35 20.434 3 41 28.803	19 11 41.5 19 12 2.3 +19 7 3.8

Date.	Hamburg M. T.	㉗ App. α	Log. Factor of Parallax.	㉗ App. δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars. α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
1854, Feb. 20	6 58 56.1	56 28 15.6	9.2535	+19 44 40.0	9.8040	3	3 46 11.172 3 46 31.072	+19 10 2.0 19 39 54.9
25	9 59 48.1	58 40 48.0	9.6968	20 16 1.2	9.8738	6	3 55 47.088	20 16 25.9
26	8 2 55.4	59 5 21.1	9.5926	20 21 33.4	9.7699	10	3 51 13.317 3 55 24.066 3 55 47.075 3 56 23.592	20 38 29.7 20 39 48.5 20 16 26.0 20 27 17.4
Mar. 1	8 12 17.6	60 26 26.9	9.6292	20 39 12.8	9.7710	13	3 58 33.287 3 59 8.142 4 3 38.860 4 4 14.020 4 7 6.296	20 51 58.2 20 52 14.1 20 21 50.8 20 21 23.8 20 27 2.4
2	7 59 28.0	60 53 46.7	9.6058	20 45 10.1	9.7683	7	3 58 33.227 3 59 8.082 4 7 6.236	20 51 57.9 20 52 14.1 20 27 2.2
3	7 58 40.1	61 21 37.0	9.6091	20 50 56.8	9.7680	5	3 58 33.186 3 59 8.041 4 10 23.553 4 10 49.252 4 10 57.336	20 51 57.6 20 52 13.8 20 56 29.1 20 47 8.3 20 42 29.2
4	7 52 29.1	61 49 30.5	9.5997	20 56 34.1	9.7654	8	4 10 23.537	20 56 29.0
6	7 46 24.3	62 46 5.1	9.5955	+21 8 5.4	9.7627	15	4 9 44.343 4 10 23.505	21 13 8.9 +20 56 29.0

HYGEA.

Date.	Hamburg M. T.	⑩ App. α	Log. Factor of Parallax.	⑩ App. δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars. α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
1854, Jan. 20	11 3 13.9	141 52 39.3	9.5564*n*	+12 26 39.7	9.8323	8	9 26 26.921	+12 10 38.6
24	9 44 16.5	141 9 17.9	9.6782*n*	12 35 36.1	9.8461	16	9 24 44.708 9 25 6.200	12 22 40.9 12 21 8.7
29	11 48 52.9	140 9 33.0	9.1725*n*	12 48 9.4	9.8158	7	9 20 35.441 9 23 11.088	12 49 50.0 12 29 49.5
29	12 44 59.8	140 9 14.0		12 48 17.3	9.8131	M.C.	⑩ occulted a	small star.
Feb. 2	9 14 20.2	139 22 10.0	9.6585*n*	12 58 42.0	9.8404	5	9 20 35.440	+12 49 49.9
15	11 24 17.2	136 40 37.9		13 35 40.9	9.8060	M.C.		
23	10 46 49.2	135 10 12.0		13 57 13.5	9.8027	M.C.		
26	10 32 58.8	131 39 26.2		14 4 29.4	9.8016	M.C.		
Mar. 1	10 19 16.6	131 10 41.6		+14 11 19.5	9.8005	M.C.		

FORTUNA.

Date.	Hamburg M. T	⑲ App. α	Log. Factor of Parallax.	⑲ App. δ	Log. Factor of Parallax.	No of Comp.	Apparent Places of Comparison-Stars. α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
1854, Feb. 2	10 56 1.4	147 20 1.0	9.4895*n*	+10 40 34.4	9.8410	6	9 50 14.509	+10 23 21.4
4	10 26 56.0	146 51 41.8	9.5164*n*	10 50 28.1	9.8430	16	9 47 36.684	10 48 3.0
5	9 9 1.7	146 38 4.4	9.6900*n*	10 55 23.0	9.8580	8	9 46 11.015	10 56 37.6
7	9 36 2.1	146 8 25.2	9.6294	11 5 49.4	9.8485	6	9 46 11.039 9 47 36.721	10 56 37.4 10 48 2.9
15	11 54 6.0	144 9 3.5		11 48 26.9	9.8218	M.C.		
23	11 15 13.6	142 17 27.9		12 29 42.5	9.8158	M.C.		
26	11 0 50.5	141 38 30.6		12 43 35,8	9.8138	M.C.		
Mar. 1	10 46.7			12 57 40.8	9.8117	M.C.		
2	10 41 56.5	140 50 47.4		13 2		M.C.		
2	11 39 13.5	140 50 10.7	9.1817	+13 1 48.8	9.8139	4	9 20 39.238	+13 1 8.7

MELPOMENE.

Date.	Hamburg M. T.	⑱ App. α	Log. Factor of Parallax.	⑱ App. δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars. α	δ
	h. m. s	° ′ ″		° ′ ″			h. m. s.	° ′ ″
1854, Feb. 15	10 32 48.7	123 46 21.3		+14 38 34.0	9.7963	M.C.		
23	9 56 13.2	122 19 7.5		15 38 14.1	9.7867	M.C.		
25	11 41 45.4	122 14 13.7	9.4737	15 52 25.4	9.7984	11	8 8 51.154 8 9 21.903	+15 45 44.7 15 45 36.4
26	9 43 1.1	122 7 58.7		15 58 39.0	9.7833	M.C.		
Mar. 1	9 30 3.2	121 50 21.5		16 17 55.0	9.7801	M.C.		
2	9 25 47.4	121 45 22.9		16 24 4.3	9.7791	M.C.		
3	9 21 33.8	121 40 56.3		16 30 7.6	9.7781	M.C.	⑱ in conj. with a	star of the 6 mag.
4	9 17 14.7	121 36 52.8		16 35 59.6	9.7771	M.C.		
6	9 9 3.8	121 30 20.7		+16 47 24.8	9.7752	M.C.		

LUTETIA.

Date.	Hamburg M. T.	㉑ App α	Log. Factor of Parallax.	㉑ App. δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars. α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
1854, Feb. 7	10 21 44.9	153 35 29.5	9.6043*n*	+15 33 25.5	9.8138	3	10 13 59.670	+15 42 31.5
16	9 31 50.3	151 25 56.2	9.6191*n*	16 26 44.0	9.8088	4	10 2 50.097	16 25 25.5
26	10 10 21.9	149 4 10.7	9.3314*n*	17 15 46.9	9.7782	4	9 59 23.049	17 28 19.3
Mar. 1	10 11 7.1	148 23 47.9	9.2435*n*	17 29 26.1	9.7731	2	9 49 35.326 9 49 44.719 9 50 1.489	17 9 4.1 17 9 10.3 17 10 25.5
2	10 15 11.1	148 9 57.7	9.1810*n*	17 33 43.4	9.7711	7	9 49 0.373	17 41 57.1
4	9 8 33.8	147 41 23.5	9.4731*n*	+17 41 54.9	9.7815	6	9 49 0.391	+17 44 57.2
4	8 43 55	Occulted a small fixed star.						

BELLONA.

Date.	Hamburg M. T.	App. α	Log. Factor of Parallax.	App. δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Compared Stars. α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
1854, Mar. 3	12 6 23.2	181 5 20.8	9.2713*n*	+7 20 5.2	9.8594	10	12 8 49.394	+7 2 0.9
4	10 21 23.9	180 55 53.4	9.6153*n*	7 28 41.6	9.8687	7	12 3 41.278	7 29 28.1
6	10 27 30.4	180 35 38.0	9.5848*n*	+7 47 31.4	9.8650	6	12 0 15.875 12 3 41.298	7 34 52.0 +7 29 28.2

AMPHITRITE.

Date.	Hamburg M. T.	App. α	Log. Factor of Parallax.	App. δ	Log. Factor of Parallax.	No. of Comp.	Apparent Places of Comparison-Stars. α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s	° ′ ″
1854, March 6	11 23 13.3	198 45 58.0	9.6213*n*	—10 4 3.6	9.9373	10	13 16 16.753	—10 6 28.1

THE Secretary of the Smithsonian Institution and the Superintendent of the Nautical Almanac, having published an accurate computation of the phases of the Solar Eclipse of May 26, have contributed a number of copies to accompany every copy of the *Astronomical Journal* distributed in the United States.

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COMPARISON OF THE BRITISH ASSOCIATION CATALOGUE OF STARS WITH THE GREENWICH TWELVE-YEAR CATALOGUE.

By ELIAS LOOMIS,

PROFESSOR OF MATHEMATICS AND NATURAL PHILOSOPHY IN THE UNIVERSITY OF THE CITY OF NEW YORK.

Having had occasion to institute a somewhat extensive comparison between the British Association Catalogue of Stars and the Greenwich Twelve-Year Catalogue, I have thought some of the results sufficiently important to be communicated to the public for the benefit of astronomers. The following table contains all the stars of the fifth magnitude and upwards which are common to both catalogues, and in which the difference of right-ascensions amounts to at least $0^s.15$. In reducing the places in the Greenwich Catalogue to the year 1850, allowance has been made for the secular variation of the precession.

Comparison of the Right Ascension of certain Stars in the British Association Catalogue with their Places in the Greenwich Twelve-Year Catalogue, reduced to 1850.

B. A. C. Number.	B. A. C. Right-Ascension.	Greenwich Right-Ascension.	B. — Gr.	B. A. C. Number.	B. A. C. Right-Ascension.	Greenwich Right-Ascension.	B. — Gr.
	h. m. s.	s.	s.		h. m. s.	s.	s.
62	0 11 47.18	46.92	+0.26	1614	5 5 38.36	38.73	—0.37
218	40 3.23	3.40	—0.17	1723	22 58.09	57.63	+0.46
227	41 33.68	33.42	+0.26	1766	28 39.99	40.14	—0.15
253	47 41.49	41.83	—0.34	1768	29 0.15	0.35	—0.20
259	48 26.80	26.38	+0.42	1878	45 40.39	40.61	—0.22
262	49 7.91	9.55	—1.64	1885	47 10.63	10.44	+0.19
288	0 55 9.99	9.75	+0.24	1922	52 13.20	13.03	+0.17
330	1 0 48.94	49.11	—0.17	1943	5 56 44.67	44.97	—0.30
339	1 59.76	59.95	—0.19	1979	6 2 11.65	11.99	—0.34
360	5 1.42	0.83	+0.59	1980	2 18.37	18.53	—0.16
453	23 27.95	27.80	+0.15	1992	4 4.54	4.90	—0.36
559	42 13.23	13.00	+0.23	2157	28 33.38	32.88	+0.50
564	43 39.33	39.68	—0.35	2248	44 16.33	16.56	—0.23
595	49 43.63	43.96	—0.33	2326	6 59 12.40	11.96	+0.44
600	1 50 43.81	44.28	—0.47	2349	7 2 47.31	47.52	—0.21
744	2 16 46.55	46.71	—0.16	2485	25 1.49	1.33	+0.16
863	39 47.13	47.50	—0.37	2707	7 57 48.59	49.11	—0.52
947	53 57.87	57.70	+0.17	2792	8 12 25.06	25.34	—0.28
948	2 54 18.16	18.40	—0.24	2971	38 49.94	49.78	+0.16
997	3 5 42.25	42.08	+0.17	3075	53 21.76	21.54	+0.22
1001	6 50.17	51.15	—0.98	3087	55 8.97	9.18	—0.21
1099	25 51.20	51.02	+0.18	3099	8 57 7.15	7.36	—0.21
1138	34 55.11	55.45	—0.34	3140	9 5 21.69	21.45	+0.24
1147	35 58.56	58.74	—0.18	3199	15 15.21	15.42	—0.21
1203	44 12.88	13.81	—0.93	3221	19 38.75	38.53	+0.22
1254	55 25.61	25.82	—0.21	3232	21 8.02	7.77	+0.25
1266	3 57 47.46	47.24	+0.22	3315	31 19.28	19.08	+0.20
1333	4 12 13.29	12.86	+0.43	3346	40 16.82	16.98	—0.16
1409	25 20.61	20.41	+0.20	3453	59 9.05	8.85	+0.20
1419	26 58.45	58.23	+0.22	3457	9 59 56.47	56.27	+0.20
1474	4 39 10.52	9.48	+1.04	3459	10 0 22.95	22.74	+0.21

B. A. C. Number.	B. A. C. Right-Ascension.	Greenwich Right-Ascension.	B. — Gr.
	h. m. s.	s.	s.
3533	10 13 22.61	22.36	+0.25
3572	19 11.80	11.64	+0.16
3580	20 59.63	59.82	—0.19
3652	32 15.07	15.29	—0.22
3729	45 19.61	19.44	+0.17
3777	54 25.93	25.72	+0.21
3788	10 57 16.77	16.61	+0.16
3848	11 9 2.28	2.12	+0.16
3856	10 56.68	56.51	+0.17
3877	16 6.21	5.83	+0.38
3885	17 27.73	27.47	+0.26
3900	20 13.50	13.31	+0.19
3981	38 6.77	6.53	+0.24
4015	11 45 20.77	20.46	+0.31
4126	12 8 36.01	35.84	+0.17
4330	46 33.60	33.41	+0.19
4340	48 3.06	2.89	+0.17
4346	49 0.37	0.17	+0.20
4366	54 16.93	16.67	+0.26
4384	12 58 43.41	43.20	+0.21
4421	13 4 52.20	52.01	+0.19
4433	6 54.32	54.62	—0.30
4449	10 34.11	33.88	+0.23
4538	28 19.19	18.98	+0.21
4568	35 2.73	2.54	+0.19
4579	37 11.11	10.64	+0.47
4597	40 8.23	8.04	+0.19
4623	43 11.26	11.00	+0.26
4629	44 35.57	35.42	+0.15
4646	47 2.98	3.14	—0.16
4686	13 57 52.49	51.61	+0.88
4789	14 20 5.49	5.32	+0.17
4812	26 2.41	2.20	+0.21
4822	27 54.20	54.43	—0.23
4823	28 8.83	9.02	—0.19
4890	41 6.38	6.22	+0.16
4891	41 29.64	29.44	+0.20
4950	14 55 18.31	18.10	+0.21
5032	15 8 43.21	42.96	+0.25
5079	17 15.75	15.32	+0.43
5190	35 38.69	38.18	+0.21
5191	35 58.56	58.15	+0.41
5227	41 26.30	26.51	—0.21
5272	47 38.19	37.93	+0.26
5279	48 47.85	47.63	+0.22
5289	15 49 47.31	47.12	+0.19
5386	16 3 48.35	48.53	—0.18
5406	5 56.15	55.91	+0.24
5459	14 45.27	45.56	—0.29
5462	15 8.19	9.79	—1.60
5495	19 41.96	41.78	+0.18
5502	21 8.48	8.75	—0.27
5511	21 57.43	57.21	+0.22
5520	23 21.34	21.16	+0.18
5539	26 33.29	33.13	+0.16
5632	40 27.67	27.43	+0.24
5667	44 50.62	50.79	—0.17
5708	50 34.36	34.21	+0.15
5740	16 55 12.55	12.74	—0.19
5780	17 1 29.87	31.25	—1.38
5785	2 13.87	13.66	+0.21
5876	17 17 12.86	12.69	+0.17
5907	17 22 16.18	16.01	+0.17
5937	27 2.88	2.72	+0.16
5950	29 13.50	13.33	+0.17
5972	32 34.49	34.21	+0.28
5990	35 14.36	14.11	+0.24
5996	36 3.92	3.68	+0.24
6020	40 22.39	22.23	+0.16
6074	49 27.42	27.22	+0.20
6089	52 50.31	50.09	+0.22
6114	56 9.90	10.30	—0.40
6129	17 59 13.55	13.82	—0.27
6218	18 12 21.92	21.41	+0.51
6229	13 32.97	33.14	—0.17
6255	17 42.34	42.50	—0.16
6289	21 43.19	42.93	+0.26
6371	36 17.15	16.97	+0.18
6460	48 45.78	45.58	+0.20
6462	48 47.15	46.90	+0.25
6489	53 4.14	3.77	+0.37
6521	18 57 34.45	34.27	+0.18
6564	19 4 32.63	32.40	+0.23
6584	8 51.47	51.29	+0.18
6601	11 14.51	14.32	+0.19
6619	12 58.34	58.18	+0.16
6706	27 34.55	34.39	+0.16
6729	31 47.55	47.36	+0.19
6735	32 38.25	38.53	—0.28
6742	33 56.26	56.10	+0.16
6817	45 28.23	28.47	—0.24
6832	47 44.24	44.09	+0.15
6877	19 51 48.74	48.47	+0.27
6926	20 2 7.46	7.69	—0.23
6934	3 33.93	33.76	+0.17
6937	3 51.61	51.43	+0.18
6991	12 20.49	20.30	+0.19
6999	13 1.03	1.76	—0.73
7005	13 50.60	50.39	+0.21
7042	20 18.03	17.88	+0.15
7088	26 2.83	2.66	+0.17
7122	30 35.44	35.24	+0.20
7177	37 12.49	12.31	+0.18
7196	39 33.37	33.13	+0.24
7220	42 13.69	13.97	—0.28
7239	44 33.71	33.56	+0.15
7256	48 10.22	10.05	+0.17
7281	52 16.29	16.14	+0.15
7291	53 7.27	7.61	—0.34
7299	51 13.55	13.17	+0.38
7305	20 55 51.79	51.59	+0.20
7386	21 8 50.13	49.71	+0.42
7407	13 53.46	53.20	+0.26
7525	31 46.58	46.40	+0.18
7542	33 53.47	53.84	—0.37
7588	39 42.19	42.86	—0.67
7597	41 12.87	13.03	—0.16
7686	57 5.21	5.37	—0.16
7691	58 19.93	19.77	+0.16
7700	21 59 27.01	26.04	+0.97
7749	22 5 39.29	39.53	—0.24
7778	9 30.93	31.13	—0.20
7815	17 39.88	40.35	—0.47
7840	22 22 42.37	42.20	+0.17

B. A. C. Number.	B. A. C. Right-Ascension.	Greenwich Right-Ascension.	B. — Gr.	B. A. C. Number.	B. A. C. Right-Ascension.	Greenwich Right-Ascension.	B. — Gr.
	h. m. s.	s.	s.		h. m. s.	s.	s.
7855	22 25 7.14	7.35	—0.21	8221	23 30 14.22	14.43	—0.21
7896	32 3.41	3.90	—0.49	8233	32 13.96	14.40	—0.44
7980	46 41.11	40.95	+0.16	8238	33 14.20	14.02	+0.18
7992	49 20.77	21.03	—0.26	8243	34 23.84	23.57	+0.27
8032	22 56 30.38	30.53	—0.15	8341	53 59.41	59.60	—0.19
8071	23 3 8.25	8.53	—0.28	8349	54 16.11	15.96	+0.15
8082	5 41.29	41.49	—0.20	8366	57 22.65	23.00	—0.35
8113	10 43.01	42.65	+0.36	8368	23 57 39.51	39.39	+0.15
8162	23 18 11.58	11.95	—0.37				

If we multiply each of the preceding differences by the cosine of the star's declination, in order to reduce them all to their equatorial values, some of the remaining differences will still be quite large. The following are all which amount to a quarter of a second.

B. A. C. Number.	Name.	Mag.	Difference.	No. of Obs.	B. A. C. Authority.	B. A. C. Number.	Name.	Mag.	Difference.	No. of Obs.	B. A. C. Authority.
			s						s.		
4686	θ Centauri,	2½	+0.72	2	B. P. T. etc.	7386	1 Piscis Aust.,	5	+0.35	3	B. P. T. etc.
8233	ι Piscium,	4½	—0.44	153	B. P. T. etc.	259	η Andromedæ,	4	+0.33	5	B. P. T.
1203	Camelopardi,	5	—0.43	3	P. T. etc.	6189	ζ Sagittarii,	3½	+0.32	6	B. P. T. etc.
7700	ξ Cephei,	5	+0.43	2	B. P. T.	1614	14 Aurigæ,	5	—0.31	3	B. P. T.
1474	α Camelopardi,	4	+0.42	3	P. T. etc.	8113	γ Sculptoris,	5	+0.30	2	P. T. etc.
1001	Cassiopeæ,	5	—0.41	5	B. P. T. etc.	1138	ο Persei,	4	—0.29	3	P. T. etc.
4579	1 Centauri,	5	+0.40	2	B. P. T. etc.	7815	β Lacertæ,	4½	—0.29	3	B. P. T.
1723	χ Aurigæ,	5	+0.39	3	B. P. T. etc.	8243	λ Piscium,	5	+0.27	16	B. P. T. etc.
6218	Lyræ,	5	+0.39	4	Groombridge.	62	ι Ceti,	4	+0.26	5	B. P. T. etc.
5462	19 Ursæ Minoris,	5	—0.38	3	B. P. T.	4015	Hydræ,	4	+0.26	1	B. P. T. etc.
3877	ι Leonis,	4	+0.37	1	B. P. T. etc.	6162	Serpentis,	5	+0.25	1	B. P. T. etc.
1333	ν^1 Eridani,	3½	+0.36	1	B. P. T. etc.						

In the preceding table, column fourth shows the difference of R.A. between the British Association Catalogue and the Greenwich Catalogue multiplied by the cosine of the star's declination; column fifth shows the number of observations from which the Greenwich result is derived, and column sixth shows the authority for the position assigned in the British Association Catalogue, where B. stands for Bradley, P. for Piazzi, and T. for Taylor; also, *etc.* shows that the place depends partly upon other authority than the preceding.

Thirteen of these stars have been observed at Greenwich since 1847, the date of the Twelve-Year Catalogue. The following table shows the result of each year's observations from 1848 to 1851, together with those from 1836 to 1847, and the average of all the observations for the sixteen years from 1836 to 1851, the observations being all reduced to the year 1850. The last column shows the difference between the British Association Catalogue and the Greenwich observations reduced to an arc of a great circle.

B. A. C. Number.	1836 - 41.		1842 - 47.		1848.		1849.		1850.		1851.		1836 - 51.		Difference B. — Gr.	Difference Reduced.
	R.A.	No. of Obs.	R.A.	No. of Obs.	R.A.	No. of Obs.	R.A.	No. of Obs.	R.A.	No. of Obs.	R.A.	No. of Obs.	R.A.	No. of Obs.		
	s.		s.		s.		s.		s.		s.		s.		s.	s
4686			51.61	2					51.15	3	51.39	1	51.34	6	+1.15	+0.93
1474			9.48	3			9.39	1	9.10	1	9.57	1	9.42	6	+1.10	+0.45
8233	14.43	78	14.37	75	14.15	20	14.22	12	14.24	18	14.19	11	14.34	214	—0.38	—0.38
1723	57.63	3			57.96	1							57.71	4	+0.38	+0.32
1138	55.45	3									55.55	1	55.48	4	—0.37	—0.31
8113			42.65	2	42.68	1							42.66	3	+0.35	+0.29
8243	23.52	9	23.61	7					23.46	1	23.42	1	23.55	18	+0.29	+0.29
1333			12.86	1			13.05	1					12.96	2	+0.33	+0.27
259	26.38	5							26.46	3	26.61	4	26.48	12	+0.32	+0.25
4015			20.46	1	20.44	2			20.52	1			20.47	4	+0.30	+0.25
62	46.92	5							47.12	4	47.07	4	47.03	13	+0.15	+0.15
6462	46.90	1			47.09	3							47.04	4	+0.11	+0.11
3877	5.83	1							6.18	5			6.12	6	+0.09	+0.09

Three of the preceding differences, namely, for stars 62, 3877, and 6162 fall below 0″.25; and it will be noticed that the places of two of them in the Twelve-Year Catalogue depended upon one solitary observation. The average of the differences for the ten remaining stars for the sixteen years is the same as for the first twelve years, although the number of observations is nearly doubled; indicating that these differences would not probably be materially reduced by any further increase in the number of observations.

The following table contains all the stars of the fifth magnitude and upwards which are common to the British Association Catalogue and the Twelve-Year Catalogue, and in which the difference of North Polar Distance amounts to at least 1″.5. In reducing the places in the Greenwich Catalogue to the year 1850, allowance has been made for the secular variation of the precession.

Comparison of the North Polar Distances of certain Stars in the British Association Catalogue with their Places in the Greenwich Twelve-Year Catalogue, reduced to 1850.

B. A. C. Number.	B. A. C. Polar Distance.	Greenwich Polar Distance.	B. — Gr.	B. A. C. Number.	B. A. C. Polar Distance.	Greenwich Polar Distance.	B. — Gr.
	° ′ ″	″	″		° ′ ″	″	″
4	61 44 14.1	16.1	—1.7	2047	67 24 51.7	53.3	—1.6
7	31 40 38.1	39.9	—1.5	2066	123 21 48.6	53.9	—5.3
164	61 30 9.8	11.9	—2.1	2163	73 28 37.0	39.4	—2.4
166	59 57 40.3	38.5	+1.8	2206	76 56 47.4	52.0	—4.6
215	66 32 57.6	59.4	—1.8	2223	48 2 51.5	53.5	—2.0
222	83 13 54.4	56.5	—2.1	2246	122 20 19.5	22.0	—2.5
420	98 57 30.1	32.2	—2.1	2345	116 9 29.3	31.1	—1.8
448	84 37 55.0	53.2	+1.8	2349	30 6 13.6	10.4	+3.2
488	78 37 35.7	38.1	—2.4	2362	73 35 25.3	28.9	—3.6
522	40 4 10.6	9.1	+1.5	2398	73 11 34.1	37.7	—3.6
541	115 48 12.6	14.9	—2.3	2486	73 51 15.4	19.0	—3.6
595	19 49 28.5	26.5	+2.0	2493	62 46 30.6	33.1	—2.5
648	67 14 56.4	57.9	—1.5	2617	62 51 1.8	3.6	—1.8
872	63 21 38.1	40.7	—2.6	2774	125 26 59.1	53.5	+5.6
1001	24 54 10.5	8.5	+2.0	2792	36 18 6.8	8.6	—1.8
1034	69 23 52.0	50.2	+1.8	2793	46 20 6.7	8.2	—1.5
1057	81 30 8.0	10.7	—2.7	2819	28 47 9.0	10.8	—1.8
1100	99 58 11.6	8.3	+3.3	2901	83 46 33.7	36.1	—2.4
1133	27 8 7.9	6.4	+1.5	2935	124 46 47.6	50.2	—2.6
1139	47 53 59.6	61.5	—1.9	2937	67 59 42.3	44.7	—2.4
1148	100 16 29.6	28.0	+1.6	2964	122 38 50.3	55.4	—5.1
1151	66 0 25.6	28.0	—2.4	3048	41 22 21.5	24.4	—2.9
1176	66 24 33.2	35.0	—1.8	3055	77 33 51.7	53.8	—2.1
1207	58 33 57.6	59.4	—1.8	3087	22 31 45.6	48.0	—2.4
1241	77 56 13.8	15.8	—2.0	3111	78 43 49.4	52.8	—3.4
1333	124 10 3.6	6.4	—2.8	3125	27 57 47.9	51.0	—3.1
1356	72 54 26.8	29.2	—2.4	3140	35 21 48.9	46.7	+2.2
1367	67 31 51.2	53.1	—1.9	3250	78 2 15.8	19.3	—3.5
1372	124 22 7.1	10.0	—2.9	3415	81 11 16.9	18.4	—1.5
1420	73 47 47.0	49.0	—2.0	3453	72 30 27.3	29.5	—2.2
1456	33 30 56.4	58.0	—1.6	3457	79 16 7.8	9.5	—1.7
1558	48 58 26.1	28.2	—2.1	3578	120 18 21.0	23.4	—2.4
1575	112 34 32.6	34.1	—1.5	3580	33 15 6.2	8.1	—1.9
1613	41 9 31.5	39.5	—5.0	3647	23 29 56.7	60.1	—3.4
1681	61 31 27.4	29.5	—1.1	3729	46 0 44.6	46.4	—1.8
1687	83 47 25.7	27.7	—2.0	3859	103 58 5.3	3.4	+1.9
1695	68 11 41.3	47.5	—3.2	3877	78 38 39.4	41.5	—2.1
1722	81 10 14.5	16.9	—2.4	3982	82 37 47.5	49.4	—1.9
1765	91 18 6.5	8.2	—1.7	4002	87 23 23.0	25.2	—2.2
1767	68 57 13.3	14.9	—1.6	4015	123 4 24.9	26.5	—1.6
1794	92 1 35.4	37.2	—1.8	4126	48 30 13.9	15.9	—2.0
1823	112 30 0.7	2.8	—2.1	4151	85 51 5.0	6.5	—1.5
1885	35 41 1.9	3.4	—1.5	4328	67 56 16.3	19.3	—3.0
1922	125 18 12.9	10.8	+2.1	4330	98 43 20.0	23.4	—3.4
1939	69 51 49.9	48.1	+1.8	4366	32 49 24.0	26.6	—2.6
1943	31 3 12.1	10.4	+1.7	4384	53 23 48.3	50.6	—2.3
2031	125 5 40.7	37.2	+3.5	4390	61 34 6.9	8.4	—1.5

B. A. C. Number.	B. A. C. Polar Distance.	Greenwich Polar Distance.	B. — Gr.
	° ′ ″	″	″
4406	71 40 31.9	33.6	—1.7
4418	105 23 15.1	17.1	—2.0
4421	61 21 34.6	37.3	—2.7
4433	49 3 5.0	6.7	—1.7
4449	107 28 28.6	31.6	—3.0
4451	48 38 8.9	10.5	—1.6
4458	125 55 10.1	12.2	—2.1
4552	52 56 24.2	25.8	—1.6
4568	34 33 29.9	28.4	+1.5
4579	122 16 57.4	59.5	—2.4
4603	123 41 58.3	60.1	—1.8
4629	121 11 3.9	5.6	—1.7
4648	70 50 50.5	54.2	—3.7
4686	125 37 46.9	49.4	—2.5
4696	24 54 22.9	24.4	+1.5
4855	95 0 10.6	12.2	—1.6
4880	115 27 23.3	20.5	+2.8
4882	116 0 53.9	50.9	+3.0
4890	103 31 12.5	14.0	—1.5
4939	97 55 11.4	13.0	—1.6
4969	62 27 52.0	53.6	—1.6
5089	106 11 20.8	22.9	—2.1
5138	117 37 58.6	61.5	—2.9
5176	109 11 15.9	18.6	—2.7
5190	105 11 25.3	27.1	—1.8
5279	33 43 46.1	42.6	+3.5
5290	103 50 29.9	32.5	—2.6
5302	62 41 2.4	4.7	—2.3
5342	110 27 28.9	31.0	—2.1
5381	117 31 53.5	55.1	—1.6
5382	109 3 54.1	58.8	—4.7
5459	29 51 49.3	47.5	+1.8
5489	108 6 37.8	40.1	—2.3
5495	98 1 51.1	55.3	—4.2
5502	34 27 8.6	6.9	+1.7
5508	124 22 20.7	24.8	—4.1
5511	13 51 9.0	4.8	+4.2
5519	111 8 23.5	28.1	—4.6
5523	47 47 5.8	7.5	—1.7
5539	117 53 56.0	58.0	—2.0
5579	107 26 46.7	48.7	—2.0
5596	40 46 35.6	34.0	+1.6
5628	25 7 36.3	34.5	+1.8
5632	124 0 54.6	58.0	—3.4
5693	58 2 47.2	49.1	—1.9
5731	58 50 55.8	58.2	—2.4
5740	24 38 10.6	8.6	+2.0
5785	35 19 53.1	50.7	+2.4
5844	110 56 45.9	47.9	—2.0
5851	114 50 41.6	39.0	+2.6
5876	114 1 51.0	54.4	—3.4
5901	127 10 12.9	5.6	+7.3
5907	113 50 25.5	28.2	—2.7
5922	63 46 18.9	22.0	—3.1
5941	77 19 34.1	36.0	—1.9
5950	34 42 42.7	41.1	+1.6
5976	102 47 22.1	24.5	—2.4
5987	111 36 13.7	16.5	—2.8
6006	21 10 25.5	23.7	+1.8
6008	117 46 2.3	4.8	—2.5
6018	126 59 22.3	29.2	—6.9
6047	17 46 43.7	45.9	—2.2
6077	113 47 45.3	48.3	—3.0
6082	52 43 33.7	35.4	—1.7
6094	73 14 8.7	12.0	—3.3
6123	87 27 36.7	38.7	—2.0
6178	58 37 40.3	43.7	—3.4
6186	126 48 1.0	8.2	—7.2
6209	119 53 12.8	10.6	+2.2
6218	49 7 15.3	11.7	+3.6
6229	92 55 57.8	60.3	—2.5
6233	124 26 56.5	60.5	—4.0
6255	40 57 11.1	7.5	+3.6
6263	115 29 58.2	56.7	+1.5
6355	51 21 13.6	10.9	+2.7
6395	34 36 40.6	39.0	+1.6
6434	112 55 23.8	25.9	—2.1
6453	67 32 25.5	29.0	—3.5
6461	111 17 53.2	55.0	—1.8
6462	85 59 16.8	19.7	—2.9
6475	46 14 59.3	56.7	+2.6
6521	117 53 0.1	2.7	—2.6
6548	111 15 22.6	24.4	—1.8
6584	109 12 50.9	53.2	—2.3
6601	32 33 7.1	8.7	—1.6
6619	108 7 26.8	28.7	—1.9
6623	36 51 25.5	23.9	+1.6
6701	82 56 4.4	8.4	—4.0
6734	40 7 29.7	27.6	+2.1
6735	20 35 42.0	38.1	+3.9
6802	81 31 30.7	26.4	+4.3
6825	81 55 21.4	23.2	—1.8
6870	118 7 17.3	19.1	—1.8
6879	62 39 26.0	28.0	—2.0
6937	53 35 53.4	56.7	—3.3
7031	108 41 55.2	57.1	—1.9
7042	108 18 17.7	19.4	—1.7
7121	75 55 22.7	25.0	—2.3
7134	108 39 43.9	45.9	—2.0
7149	74 36 50.9	49.4	+1.5
7207	124 19 53.2	51.1	+2.1
7215	32 57 22.6	24.9	—2.3
7256	62 30 34.4	36.5	—2.1
7291	8 1 42.3	43.9	—1.6
7385	52 35 30.8	33.0	—2.2
7407	107 28 10.2	12.1	—1.9
7503	45 4 8.0	10.0	—2.0
7506	110 8 4.8	6.5	—1.7
7588	19 22 45.5	43.0	+2.5
7597	18 22 0.1	1.6	—1.5
7731	57 33 20.0	21.8	—1.8
7815	38 31 13.9	16.7	—2.8
7840	101 26 35.3	37.3	—2.0
7842	123 6 48.0	50.6	—2.6
7855	40 29 16.0	14.4	+1.6
7966	123 40 7.9	14.8	—6.9
8023	48 28 42.2	44.3	—2.1
8074	15 25 24.0	22.1	+1.9
8082	41 24 46.6	44.8	+1.8
8105	87 32 7.9	11.1	—3.2
8160	67 25 13.2	15.4	—2.2
8224	41 21 13.7	15.3	—1.6
8238	13 12 18.3	16.6	+1.7
8243	89 2 39.8	42.4	—2.6
8331	83 57 59.7	61.8	—2.1

In the preceding list we find seventeen cases in which the differences between the two Catalogues amount to at least four seconds. They are as follows: —

B. A. C. Number.	Name.	Mag.	Difference.	No. of Obs.	B. A. C. Authority.	B. A. C. Number.	Name.	Mag.	Difference.	No. of Obs.	B. A. C. Authority.
5901	31 Scorpii,	3½	+7″.3	8	B. P. T. etc.	2206	ξ Geminorum,	4	—4″.6	5	B. P. T. etc.
6186	η Sagittarii,	4	—7.2	10	P. T. etc.	5519	ω Ophiuchi,	5	—4.6	1	B. P. T. etc.
6018	Scorpii,	4	—6.9	10	P. T. etc.	6802	*a* Aquilæ,	1½	+4.3	215	B. P. T. etc.
7966	γ Piscis Aust.,	5	—6.9	4	B. P. T. etc.	5195	*v* Ophiuchi,	5	—4.2	2	P. T. etc.
2774	*r* Puppis,	5	+5.6	2	P. T. etc.	5511	η Ursæ Minoris,	5	+4.2	9	B. P. T.
2066	3 Canis Majoris,	4	—5.3	1	B. P. T. etc.	5508	Scorpii,	4	—4.1	15	P. T. etc.
2964	*a* Mali,	4½	—5.1	11	P. T. etc.	6233	ε Sagittarii,	3	—4.0	16	B. P. T. etc.
1613	Capella,	1	—5.0	318	B. P. T. etc.	6701	*u* Aquilæ,	4½	—4.0	5	B. P. T.
5382	ν^2 Scorpii,	4	—4.7	6	B. P. T. etc.						

The arrangement of this table is the same as in the corresponding one for right-ascensions.

Eight of these stars have been observed at Greenwich since 1847. The following table shows the result of each year's observations from 1848 to 1851, together with those from 1836 to 1847, and the average of all the observations from 1836 to 1851, the observations being all reduced to the year 1850. The last column shows the difference between the British Association Catalogue and the Greenwich observations.

B. A. C. Number.	1836 – 41.		1842 – 47.		1848.		1849.		1850.		1851.		1836 – 51.		Difference B. — Gr.
	N. P. D.	No. of Obs.	N. P. D.	No. of Obs.	N. P. D.	No. of Obs.	N. P. D.	No. of Obs.	N. P. D.	No. of Obs.	N. P. D.	No. of Obs.	N. P. D.	No. of Obs.	
1613	39″.37	189	39″.60	159	39″.57	32	38″.18	25	39″.32	11	39″.14	6	39″.4	422	—4″.9
5382	59.33	2	58.35	4			57.63	2	59.68	6	58.80	2	58.9	16	—4.8
6233	61.29	12	59.76	4					62.11	3	59.11	1	61.0	20	—4.5
6802	26.12	81	26.30	131	26.49	16	25.85	17	26.86	12	26.28	16	26.3	276	+4.4
5511	5.02	2	4.61	7			5.80	1					4.8	10	+4.2
6701			8.39	5					8.03	9	8.95	5	8.4	19	—4.0
5519			28.15	1			24.60	3	26.26	3			25.8	7	—2.3
2066			53.95	1			46.22	1					50.1	2	—1.5

In the case of two of these stars, Nos. 2066 and 5519, which had been observed but once for the Twelve-Year Catalogue, the differences are materially diminished by the observations since 1847; but for the six other stars, the differences are not diminished by the increased number of observations. It is very remarkable that in the case of two stars of the first magnitude, *Capella* and *a Aquilæ*, the places which were predicted in 1845 should differ nearly five seconds from the recent Greenwich observations, although these stars have been observed almost daily at Greenwich for more than a hundred years. On the other hand, the places predicted by Bessel in 1830 in the *Tabulæ Regiomontanæ* are remarkably exact, — the place of *Capella* differing only 0″.1, and that of *a Aquilæ* 1″.2 from the recent Greenwich observations.

There are two stars in the Twelve-Year Catalogue which present anomalies which I am unable to explain. The star 5060 B. A. C. was observed four times from 1836 to 1841, and once in 1843; but the two determinations reduced to 1850 differ by 20″, yet the mean of both places agrees nearly with that given in the British Association Catalogue.

The star 5845 B. A. C. was observed twice from 1836 to 1841, and five times from 1842 to 1847, but the two determinations reduced to 1850 differ by about 5″.

FROM A LETTER OF THOMAS MACLEAR, ESQ. TO THE EDITOR.

Royal Observatory, Cape of Good Hope, 1854, *March* 18.

The Cape Arc of the Meridian work is passing through the press. In the mean time I am engaged in erecting our large Transit-circle, — an instrument similar in dimensions and general construction to the Greenwich one, and provided with the mechanism for electro-magnetic registration when we shall have secured the horological. I look forward with pleasure to working this great increase of optical power, and to the comfort of securing the complete position of an object under the same eye.

The Cape observations of Klinkerfues's Comet extend from September 11, to the 11th of last January; a splendid series, which, taken in conjunction with the Northern observations from June 10 to the perihelion passage, should furnish the data for a first-rate determination of the elements of the orbit. The positions of the stars compared with it (84 in number) must bide until the Transit-circle shall have been adjusted; at least the polar distances.

The apparent angle of position of *α Centauri's* components is now 277°, and their apparent distance 1″.45. Therefore the peristellar epoch will be later than was expected. I have not as yet had time to discuss the mass of observations collected for a further investigation of the longitude of this Observatory. I am ready, as formerly mentioned, to forward the corresponding lunar transits to those that may have been made in the United States. . . . . .

The arc of the meridian measured at the Cape provides the base for a trigonometric survey of the colony, which I have reason to expect will be commenced erelong.

THOMAS MACLEAR.

OBSERVATIONS OF EUNOMIA, AND THE SECOND COMET OF 1854,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant MAURY. — Corrected for refraction.]

EUNOMIA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑮ — * Δα	⑮ — * Δδ	⑮'s apparent α	⑮'s apparent δ
1854.	h. m s.			m s.	′ ″	h. m. s.	° ′ ″
Mar. 12	9 22 4.3	2	Weisse XI. 641	+0 33.49	+8 0.01	11 37 14.21	—14 30 49.71
21	10 23 35.7	5	" 488	—1 46.85	+0 38.74	11 26 29.60	13 38 42.55
25	9 57 18.8	5	" 488	—2 36.85	+5 40.16	11 25 39.61	13 33 41.14
April 2	9 23 59.1	14	" 318	+0 42.66	+6 43.53	11 19 16.82	12 50 20.10
11	10 15 15.0	4	" 217	+0 3.73	—5 56.48	11 13 17.06	11 58 38.34
		4	" 253	—1 54.42	—7 21.86	11 13 17.07	11 58 38.45
13	10 13 32.3	4	" 217	—1 3.28	+5 26.70	11 12 10.03	11 47 14.26
		4	" 253	—3 1.65	+4 2.86	11 12 9.85	—11 47 13.84

Adopted Mean Places, 1850.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s	° ′ ″	
Weisse XI. 641	8	11 36 27.67	—14 37 24.91	Weisse's Catalogue.
" 488	9	11 28 3.40	13 37 55.23	
" 318	7	11 18 21.18	12 55 37.29	
" 217	9	11 13 0.41	11 51 15.41	
" 253	9	11 14 58.56	—11 49 49.98	

COMET 1854, II.

	Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	☄ — * Δα	☄ — * Δδ	☄'s apparent α	☄'s apparent δ
		h m. s			m s	′ ″	h. m s.	° ′ ″
(1)	April 2	7 40 47.5	6	(*x*)	+0 16.81	+ 3 33.83	2 9.9	+17 50.6
	3	7 23 31.0	14	B. A. C. 771	+0 2.57	— 2 52.41	2 22 49.99	17 0 26.21
	6	7 36 20.8	8	Weisse II. 1037	+0 52.02	— 6 38.84	2 59 24.76	14 5 43.64
	7	7 35 16.3	4	" III. 168	+0 19.31	—13 56.35	3 10 6.83	13 4 33.26
	8	7 37 12.2	7	" III. 334	+0 51.80	— 6 38.30	3 20 6.78	12 6 39.10
	11	7 45 25.5	5	Lalande 7069	+4 33.86	+ 8 19.94	3 46 23.66	9 5 55.96
	13	7 43 43.7	7	Weisse IV. 21	—1 0.59	— 1 37.66	4 1 13.42	7 17 1.85
		7 43 29.1	6	B. A. C. 1296	—4 26.77	— 3 17.79	4 1 13.68	7 17 2.44
	18	7 49 14.8	5	Weisse IV. 728	—2 11.81	+ 6 23.20	4 31 12.82	3 20 3.93
	.	7 48 51.9	5	" 732	—2 28.24	— 2 19.92	4 31 12.16	3 19 59.21
	21	7 48 59.1	4	" 972	—0 45.85	+ 1 50.50	4 43 53.01	+1 17 32.93

(1) The star of comparison is undetermined.

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 771	6	2 22 35.68	+17 2 17.38	B. A. Catalogue, and Rümker.
Weisse II. 1037	9	2 58 20.90	14 11 28.25	Weisse's Catalogue.
" III. 168	8	3 9 35.65	13 17 38.17	
" III. 334	8	3 19 3.13	12 12 28.32	
Lalande 7069	8.9	3 41 38.08	8 56 53.15	Lalande's Catalogue.
Weisse IV. 21	9	4 2 2.30	7 18 2.51	Weisse's Catalogue.
B. A. C. 1296	6	4 5 28.72	7 19 44.2	British Association Catalogue.
Weisse IV. 728	9	4 33 13.19	3 13 13.63	Weisse's Catalogue.
" 732	9	4 33 29.51	3 21 52.03	
" 972	8	4 44 27.56	+1 15 15.78	

APPROXIMATE ELEMENTS OF THE SECOND COMET OF 1854,

COMPUTED FROM THE OBSERVATIONS OF THE ABOVE SERIES OF APRIL 3, 7, AND 11,

BY MR. JAMES FERGUSON.

T	March 24.0581	M. T. Berlin.
π	214° 52′ 52″.0	M. Eq., April 7.0, 1854.
☊	316 19 58.2	
i	83 30 33.4	
Log q	9.441070	
	Motion Retrograde.	

ANNULAR ECLIPSE OF MAY 26.

THE clouds and rain have prevented observations of the Eclipse at many desirable points. The Coast Survey Station on the summit of Mount Agamenticus, almost precisely in the central line, had, by direction of Professor BACHE, been equipped with a transit instrument, and both reflecting and refracting telescopes, all which were mounted and housings for them built, by the Editor of this Journal with Messrs. HILGARD and HILL. But the sun was invisible throughout the day. The astronomers at the Cambridge Observatory, Cloverden, Dartmouth College, and Wilmington (N. C.) were also prevented by clouds from noting any of the phenomena. On the other hand, the weather at New York and Washington was most favorable; and a telegraphic dispatch from Professor ALEXANDER states that the sky at Ogdensburg was cloudless, that the phenomena were admirably seen, and daguerreotyped impressions of the annulus taken.

G.

1854, *May* 30.

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ANNULAR ECLIPSE OF MAY 26.

CAMBRIDGE: METCALF AND COMPANY, PRINTERS TO THE UNIVERSITY.

THE
ASTRONOMICAL JOURNAL.
No. 72.

VOL. III. CAMBRIDGE, 1854, JUNE 15. NO. 24.

NEW ELEMENTS OF EGERIA, AND EPHEMERIS FOR 1854.

By PROFESSOR J. S. HUBBARD,
OF THE WASHINGTON OBSERVATORY.

We are indebted to the skill and perseverance of Mr. Ferguson for the only two observations of *Egeria* in 1853 that have yet appeared.(1) The error of my ephemeris for that year (2) was unusually large, and this may have misled some in their search, although it may be presumed that the peculiar difficulties at this opposition were sufficient to prevent the generality of observers from attempting to find the planet. Mr. Ferguson's observations are as follows: —

M. T. Berlin.	⑬ α	⑬ δ	$\Delta\alpha$	C. — O. $\Delta\alpha.\cos\delta$	$\Delta\alpha$	No. of Comp.
1853, June 2.84112	286° 39′ 41″.0	—41° 27′ 17″.8	+397″.3	+297″.8	+ 1″.8	6
29.74087	279 35 45.0	—44 22 1.3	+448.4	+320.6	—38.4	6

Taking the mean of the two, I assume for the present the following normal, to be used in connection with those previously given (3) for the correction of my Elements III.

	α	δ	$\Delta\alpha.\cos\delta$	$\Delta\alpha$
1853, June 19.0	282° 50′ 6″.9	—43° 27′ 43″.9	+309″.2	—18″.3

We have now for the whole series of residuals thus far obtained: —

	$\Delta\alpha.\cos\delta$	$\Delta\alpha$		$\Delta\alpha.\cos\delta$	$\Delta\alpha$
1850, Nov. 22	+2″.4	—0″.1	1852, Feb. 13	+ 11″.3	— 6″.2
Dec. 20	—3.0	+1.3	Mar. 16	+ 10.9	— 1.3
1851, Jan. 17	—0.7	+0.5	Apr. 1	+ 4.8	+ 0.6
Feb. 14	—1.7	+0.4	May 19	+ 4.8	—11.1
Mar. 14	+0.3	—1.9	July 18	+ 6.9	—17.6
Apr. 19	+0.2	+2.4	1853, June 19	+309.2	—18.3
Nov. 29	—0.6	—1.2			

The five normals in 1852, and the one in 1853, furnish twelve more equations in addition to those given in No. 35 of this journal,(4) viz.: —

Right-Ascensions.

	ΔM	$\Delta 100\mu$	$\Delta\varphi$	$\Delta\omega$	$\Delta\Omega$	Δi
1852, Feb. 13	0.12582	0.78351	0.29605	0.07614	0.10236	9.90425
Mar. 16	0.18019	0.82608	0.33994	0.13084	0.16281	9.86989
Apr. 1	0.16731	0.80670	0.32425	0.11758	0.15234	9.81553
May 19	0.02628	0.66896	0.21371	9.97949	0.02783	9.59120
July 18	9.85828	0.55327	0.11746	9.82824	9.89582	9.28242
1853, June 19	0.11408	1.07613	0.00272	0.18182	0.16833	n8.89073

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(1) *Astron. Journ.*, Vol. III. p. 135.

(2) *Ibid.*, pp. 49, 50.

(3) *Ibid.*, Vol. II. pp. 68, 81, and Vol. III. p. 5.

(4) *Ibid.*, Vol. II. p. 81.

Declinations.

	ΔM	$\Delta 100\mu$	$\Delta\varphi$	$\Delta\omega$	$\Delta\Omega$	Δi
1852, Feb. 13	n0.03714	n0.64047	n0.11285	n9.97850	n9.87303	0.03195
Mar. 16	n0.02117	n0.62325	n0.11492	n9.96357	n9.81487	0.02667
Apr. 1	n9.97529	n0.58283	n0.08851	n9.91921	n9.73929	9.99488
May 19	n9.83874	n0.49465	n0.03880	n9.79509	n9.55327	9.79096
July 18	n9.74264	n0.46651	n0.01641	n9.72085	n9.48916	9.42378
1853, June 19	n8.80663	n9.93536	8.97057	n8.90835	9.25610	n0.08494

Introducing into the whole series of equations the values of the residuals as given above, and solving, I obtained the subjoined results: —

ELEMENTS IV.

1851, Jan. 1.0 Mean Time Berlin.

$\Delta M = +278''.25$	M	299° 7′ 43″.58			
$\Delta\Omega = -\ 2.12$	Ω	43 17 3.27	Ω_0	18° 51′ 32″.16	Mean Equinox, 1851.0
$\Delta\omega = -230.32$	ω	75 44 17.09	ω_0	102 35 20.92	
$\Delta i = +\ 4.30$	i	16 33 8.56	i_0	37 10 37.36	
$\Delta\varphi = +\ 36.52$	φ	4 53 25.91			
$\Delta\mu = -\ 0.29672$	μ	857″.7580			

Residuals.

	$\Delta\alpha.\cos\delta$	$\Delta\delta$		$\Delta.\alpha\cos\delta$	$\Delta\delta$
1850, Nov. 22	+3.3	—0.4	1852, Feb. 13	+1″.4	—1″.6
Dec. 20	—2.0	+1.0	Mar. 16	+2.1	+1.3
1851, Jan. 17	—0.9	+0.4	Apr. 1	—1.3	+3.2
Feb. 14	—2.9	+0.6	May 19	+1.4	—3.2
Mar. 14	—1.3	—1.0	July 18	—6.5	+0.4
Apr. 19	—0.8	+4.1	1853, June 19	+0.7	+5.9
Nov. 29	+1.5	+1.5			

Resuming, with the new elements, the calculation of the perturbations by Jupiter and Saturn, I found the following continuation of the series previously given: (1) the unit of δr and δz being still in the seventh decimal place.

	δr	δu	δz		δr	δu	δz
1854, Jan. 5	+34780	— 96″.03	+5767	1854, Sept. 2	+34086	—663′.77	+7265
Feb. 14	37481	179.37	6338	Oct. 12	29529	755.41	6943
Mar. 26	39197	270.11	6809	Nov. 21	23678	836.88	6432
May 5	39803	366.36	7156	Dec. 31	16631	903.69	5733
June 14	39198	465.89	7359	1855, Feb. 9	+ 8553	—951.09	+4854
July 24	+37307	—566.07	+7400				

Upon these new elements and perturbations, I have based the following ephemeris, which is probably accurate enough to afford an easy identification of the planet.

M. Noon, Berlin.	⑬ α	⑬ δ	Log △	M. Noon, Berlin.	⑬ α	⑬ δ	Log △
	h. m. s.	° ′			h. m. s.	° ′	
1854, July 29	1 46 47	—3 9.8	0.35573	1854, Aug. 30	1 53 32	—2 53.6	0.27421
Aug. 2	48 53	3 2.3	.34554	Sept. 3	52 32	2 57.9	.26447
6	50 40	2 56.4	.33524	7	51 7	3 3.2	.25574
10	52 7	52.1	.32491	11	49 15	9.2	.24724
14	53 12	49.2	.31455	15	46 57	15.7	.23937
18	53 51	48.2	.30424	19	44 14	22.7	.23220
22	54 12	48.6	.29403	23	41 9	29.6	.22590
26	1 54 5	—2 50.5	0.28399	27	1 37 42	—3 36.1	0.22052

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(1) *Astron. Journ.* Vol. III., p. 49.

M. Noon, Berlin.	⑬ α	⑬ δ	Log △	M. Noon, Berlin.	⑬ α	⑬ δ	Log △
	h. m. s.	° ′			h. m. s.	° ′	
1854, Oct. 1	1 33 57	—3 41.8	0.21617	1854, Nov. 18	0 50 7	—2 18.7	0.25105
5	29 58	46.5	.21290	22	48 23	1 55.9	.25969
9	25 48	49.7	.21081	26	47 5	30.9	.26876
13	21 32	51.4	.20989	30	46 16	1 3.8	.27820
17	17 15	50.9	.21019	Dec. 4	45 52	0 31.8	.28787
21	13 0	48.3	.21171	8	45 55	—0 4.1	.29772
25	8 52	43.3	.21438	12	46 23	+0 28.3	.30767
29	4 56	35.7	.21821	16	47 16	1 2.2	.31767
Nov. 2	1 1 16	25.4	.22306	20	48 33	1 37.4	.32765
6	0 57 54	3 12.6	.22886	24	50 12	2 14.0	.33758
10	54 54	2 57.1	.23554	28	52 13	2 51.8	.34737
14	0 52 18	—2 39.1	0.24296	32	0 54 35	+3 30.5	0.35702

OBSERVATIONS OF EUTERPE,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By JAMES FERGUSON, Esq.

[Communicated by Lieutenant Maury. — Corrected for refraction.]

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉗ — *		㉗'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1853, Dec. 13	7 11 16.7	3	Weisse II. 881	+0 18.55	+16 37.06	2 50 53.53	+11 50 40.59
	8 28 2.2	5	"	+0 17.10	+16 35.52	50 52.08	50 39.01
	10 12 29.4	3	"	+0 15.78	+16 34.83	50 50.76	50 38.35
14	6 3 37.7	22	"	—0 0.32	+16 49.22	50 34.65	50 51.73
15	6 17 36.4	14	"	—0 18.08	+16 56.37	50 16.89	50 59.86
20	6 32 36.2	14	"	—1 12.82	+20 43.22	49 22.14	14 54 46.62
24	6 12 17.2	10	(10)	+1 10.13	+14 25.44	49 19.45	15 0 42.06
27	7 49 7.0	4	"	+1 32.08	+20 47.99	49 41.39	7 4.50
	9 3 49.7	3	"	+1 33.07	+20 56.00	49 42.38	7 12.50
	9 16 8.8	3	Rümker 755	—0 26.60	—17 11.85	49 42.21	7 7.50
29	6 47 27.4	6	"	—0 1.98	—12 30.26	50 6.81	11 49.04
1854, Jan. 3	6 43 42.1	10	"	+1 41.41	+ 2 27.61	51 50.07	26 47.25
4	6 45 58.5	10	"	+2 8.93	+ 5 51.58	52 17.67	30 11.14
8	7 22 31.5	7	B. Z. 337, 20	+0 48.32	—10 52.08	2 54 28.08	15 15 32.40
22	6 30 2.8	7	" 337, 31	+3 12.42	+ 7 2.22	3 6 4.20	16 51 47.18
		7	" 337, 32	+2 1.00	+ 6 57.83	6 4.55	51 47.39
23	8 25 27.7	6	" 337, 32	+3 8.70	+12 51.95	7 12.22	57 41.36
		6	" 337, 40	—1 45.55	— 4 14.82	7 12.25	16 57 40.73
24	6 43 38.2	14	" 337, 40	—0 45.32	+ 0 52.11	8 12.48	17 2 47.82
27	7 3 7.1	14	" 337, 40	+2 39.60	+17 55.80	11 37.39	19 51.22
28	9 10 12.9	6	" 506, 55	+2 49.83	—12 10.42	12 54.76	26 9.54
Feb. 1	7 35 6.4	6	" 506, 64	—0 53.69	—25 14.79	17 49.55	49 14.98
2	7 50 7.0	6	" 506, 64	+0 25.24	—19 10.94	19 8.47	17 55 18.82
3	7 40 24.5	10	" 506, 64	+1 44.68	—13 6.80	20 27.88	18 1 22.89
6	7 46 8.5	6	Rümker 870	+3 9.24	+ 5 43.14	24 36.04	19 46.11
		6	" 879	+2 2.09	+ 1 49.55	24 36.12	19 44.99
		6	B. Z. 506, 70	+1 13.08	+ 1 47.00	24 36.41	19 43.77
10	7 13 50.8	9	" 506, 79	+0 35.80	— 8 23.22	30 22.77	18 44 31.75
18	7 16 38.4	5	" 391, 127	—3 15.87	— 6 4.38	42 58.21	19 34 0.81
		5	" 391, 128	—3 32.48	— 5 54.63	42 58.54	34 3.23
21	8 26 58.1	8	" 391, 127	+1 49.97	+12 43.75	48 4.01	52 48.83
		8	" 391, 128	+1 33.69	+12 52.73	3 48 4.06	+19 52 50.49

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉗ — *		☄'s apparent	
				Δα	Δδ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1854, March 1	8 48 4.3	7	B. Z. 342, 3	+3 42.01	—11 1.84	4 2 15.22	+20 40 57.21
		7	" 342, 4	+3 7.39	—11 12.99	2 15.55	20 41 1.66
5	7 49 55.8	14	B. A. C. 1316	—0 6.40	— 9 24.47	9 37.95	21 3 45.60
8	7 41 46.8	16	Rümker 1176	—0 1.20	+ 8 34.24	15 21.15	20 24.00
	8 5 39.3	10	B. Z. 393, 80	—0 10.90	— 3 12.38	15 22.91	20 27.89
12	7 58 55.2	8	" 393, 93	—1 42.97	—13 54.27	28 12.96	41 48.68
(1) 15	7 47 46.2	3	" 393, 94	+3 13.18	— 7 9.68	29 11.67	21 57 4.75
18	7 52 58.9	5	" 393, 100	+4 49.69	— 9 48.02	35 18.73	22 11 39.12
		5	" 393, 104	+2 21.71	— 8 47.36	35 18.46	11 39.36
20	8 39 45.2	3	" 393, 104	+6 32.99	+ 0 37.56	39 29.72	21 4.23
24	7 56 38.2	10	" 393, 120	+2 44.39	+ 6 54.30	47 48.84	38 23.94
25	7 45 52.6	10	" 393, 128	—1 50.70	+19 0.70	49 55.85	42 31.96
28	8 27 57.5	10	" 393, 137	—0 23.52	+ 3 10.90	4 56 24.84	22 54 24.77
April 11	9 6 58.2	5	B. A. C. 1742	+0 53.09	—19 15.77	5 27 25.36	23 37 5.41
May 5	8 22 48.1	5	B. Z. 348, 88	+1 11.22	+15 10.97	6 22 56.84	53 5.52
6	9 3 52.8	6	" 348, 88	+3 36.72	+16 6.33	25 22.13	52 0.24
(2) 8	8 24 20.2	9	" 348, 101	—1 9.29	+ 1 36.45	30 1.76	(50 8.39)
		9	" 348, 102	—1 30.85	+ 3 15.98	6 30 1.68	+23 49 40.64

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse II. 881	9	2 50 21.97	+14 33 3.85	Weisse's Catalogue.
(10)	10	2 47 56.35	14 45 16.58	δ Wash'n Mural, Prof. Yarnall; α Wash'n Equat.
Rümker 775	7	2 49 55.80	15 23 19.63	Rümker and Washington Mural; Prof. Yarnall.
B. Z. 337, 20	8	2 53 26.79	15 55 25.69	Bessel's Zones.
" 337, 31	9	3 2 39.12	16 43 48.46	"
" 337, 32	8.9	3 3 50.55	16 43 53.33	"
" 337, 40	8	3 8 44.77	17 1 0.42	Bessel's Zones and Rümker's Catalogue.
" 506, 55	8	3 9 51.87	17 37 25.04	Bessel's Zones.
" 506, 64	8	3 18 30.12	18 13 36.89	"
Rümker 870	8	3 21 13.73	18 13 10.94	Rümker's Catalogue.
" 879	8	3 22 20.95	18 17 3.68	" "
B. Z. 506, 70	8.9	3 23 10.23	18 17 5.20	Bessel's Zones.
" 506, 79	8.9	3 29 33.81	18 52 4.95	"
" 391, 127	9	3 46 0.94	19 39 16.83	"
" 391, 128	9	3 46 17.88	19 39 9.58	"
" 342, 3	8.9	3 58 19.91	20 51 16.61	"
" 342, 4	9	3 58 54.85	20 51 32.37	"
B. A. C. 1316	7	4 9 30.97	21 12 30.80	British Association Catalogue.
B. Z. 393, 81	8.9	4 15 8.96	21 11 12.19	Bessel's Zones (342, 27, and 393, 81) and Rümker's Catalogue.
" 393, 80	7.8	4 15 20.40	21 23 2.75	Bessel's Zones.
" 393, 93	9	4 24 42.45	21 55 8.08	"
" 393, 94	9	4 25 45.05	22 3 39.85	"
" 393, 100	9	4 30 15.51	22 20 53.94	"
" 393, 104	9	4 32 43.27	22 19 54.26	"
" 393, 120	9	4 44 50.93	22 31 1.17	"
" 393, 128	9	4 51 32.99	22 23 4.70	"
" 393, 137	8	4 56 31.78	22 50 51.78	"
B. A. C. 1742	6	5 26 17.65	23 56 5.3	British Association Catalogue.
B. Z. 348, 88	8.9	6 21 31.67	23 37 56.45	Bessel's Zones.
(2) " 348, 101	8	6 30 57.28	23 48 37.77	"
" 348, 102	8.9	6 31 18.77	+23 46 30.49	"

---

(1) Night misty.

(2) The declination of the star of comparison should probably be diminished 30″.

SECOND COMET OF 1854.

THE following observations on the first (1) comet of 1854 have been made at this place.

1854, Cambridge M. T.	☄ — ∗		Mean Places for 1850 of Comp.-Stars.		Authority.
	$\Delta\alpha$	$\Delta\delta$	∗ α	∗ δ	
h. m. s.	s.	′ ″	h. m. s.	° ′ ″	
April 2 7 47 29.86	— 26.55	+4 18.8	2 9 40.44	+17 46 38.0	H. C. 4238
3 7 9 30.90	— 17.90	—1 33.4	2 22 48.93	17 3 24.1	B. A. C. 771
4 7 47 17.61	+3 41.97	—0 41.0	2 32 3.95	+16 5 50.7	B. Z. 337, 394

The elements computed by Assistant C. W. TUTTLE from these observations are as follows : —

T	March 23.99653 Greenwich M. S. T.
π	209° 51′
☊	308 17
i	86 13
Log q	9.42335
	Motion Retrograde.

W. C. BOND.

Cambridge, H. C. Observatory.

FROM A LETTER OF PROFESSOR CHALLIS TO THE EDITOR.

Cambridge Observatory, 1854, *May* 20.

ABOUT this time last year a series of signals was transmitted between Greenwich and Cambridge. We had two nights signaling and an interchange of observers, and the experiment was altogether successful. I have only just completed my calculation of the longitude of the Observatory from the recorded signal-times, being unwilling to publish the final result till I had eliminated from the sidereal times any effect which might be produced by irregularities in the forms of the pivots of our transit-instrument. The corrections to be applied on this account were calculated by the method which I have described in the *Memoirs of the Astronomical Society*, Vol. XIX., and the mean amount was found to be 0s.32. The final determination of the longitude is 22s.69 East of Greenwich, which is 0s.85 less eastward than the value hitherto adopted. This determination will be used in future.

The signals being partly given at Greenwich, and partly at Cambridge, the interval apparently occupied by the transmission of the galvanic action between the two stations (distant from each other about 65 miles) must be inferred. I found a mean interval of about 0s.03, which undoubtedly is too large. This amount may with much probability be explained by supposing the signal to catch the eye of the observer sooner at the signal-going place than at the signal-receiving place, on account of the greater galvanic intensity at the former.

J. CHALLIS.

TWO NEW THEOREMS RELATING TO THE MOON'S ORBIT.

BY REV. JAMES CHALLIS,

DIRECTOR OF THE CAMBRIDGE (ENG.) OBSERVATORY.

THE rectangular coördinates x and y being referred to the plane of the ecliptic, the true longitudes of the moon and sun being θ and θ' and their radius-vectors r and r', and μ designating the sum of the attractions of the earth and moon at the unit of distance, and m' that of the sun, the following equations are true, inclusive of small quantities of the third order.

$$\frac{d^2 x}{d t^2} + \frac{\mu x}{r^3} - \frac{m' x}{2 r'^3} - \frac{3 m' r}{2 r'^3} \cos (\theta - 2 \theta') = 0$$

$$\frac{d^2 y}{d t^2} + \frac{\mu y}{r^3} - \frac{m' y}{2 r'^3} + \frac{3 m' r}{2 r'^3} \sin (\theta - 2 \theta') = 0$$

$$\frac{d^2 z}{d t^2} + \frac{\mu z}{r^3} + \frac{m' z}{r'^3} = 0.$$

After substituting in the small terms of the first two equations, the mean longitudes $n t + e$ and $n' t + e'$ for θ and θ', and the sun's mean distance a' for r', the following first integrals, including small quantities of the second order, may be obtained by supposing the true longitudes to differ by small quantities of the first order from the mean longitudes, without making any supposition respecting r :—

---

(1) The *second* of 1854, the comet discovered by VAN ARSDALE in Newark having been the first. — G.

$$\frac{r^2\,d\,\theta^2}{d\,t^2} = \frac{h^2}{r^2} + \frac{3\,m'\,r^2}{2\,a'^3}\cos 2\,(\theta - \theta') \qquad (1)$$

$$\frac{d\,r^2}{d\,t^2} + \frac{h^2}{r^2} - \frac{2\,\mu}{r} - \frac{m'\,r^2}{2\,a'^3} + c = 0. \qquad (2)$$

From the second of these equations, which I believe to be new, it follows that the relation between the radius-vector and the time (inclusive of the effect of tangential force), is the same as that in an orbit described by the action of the central force $\frac{\mu}{r^2} - \frac{m'\,r}{2\,a'^3}$. This is Theorem I.

On proceeding to deduce from (2) a relation between r and t by approximate integration, no appropriate result is obtained by putting for r in the small term a mean value a, the integration giving a fixed ellipse, notwithstanding the disturbing force. It is found necessary, after putting $a + r - a$ for r, to expand to the *second* power of $r - a$ in the small term, so as apparently to include small quantities of the *fourth* order. This step is legitimate, because, as said above, the value of r is not limited; and the necessity for it can only arise from the circumstance that the equation (2) contains a small quantity of the second order as a *factor*. This being understood, we readily obtain, putting p for the moon's periodic time, P for the earth's, and e for the eccentricity of the moon's orbit, the following results :—

$$r = a + a\,e\cos\psi,$$

$$\psi + e\sin\psi = \frac{c^{\frac{3}{2}}}{\mu}\left(1 - \frac{5\,p^2}{2\,P^2}\right)(t + T),$$

$$\frac{a\,(1 - \epsilon)}{r} = 1 + e\cos\left\{\left(1 - \frac{3\,p^2}{4\,P^2}\right)(\theta + \gamma)\right\}$$

$$a = \frac{\mu}{c}\left(1 + \frac{p^2}{P^2}\right);\quad e^2 = 1 - \frac{p^2\,c}{\mu^2} + \frac{p^2}{2\,P^2}.$$

We have thus arrived by a direct path at that relation between r and θ which is *assumed* in the ordinary treatment of the Lunar Theory by introducing a certain quantity usually called e. The introduction of this quantity indicates a *hiatus* in the reasoning, which the foregoing investigation fills up. It is necessary, however, to satisfy the condition on which alone the results were obtainable, viz. that the equation contains a small factor of the second order. When the values of r and $\frac{d\,r}{d\,t}$ are substituted in (2), it is at once seen that the condition is satisfied by the equation $\mu^2 = h^2\,c$. Hence it follows that $e = \frac{p}{52\,P}$. This is Theorem II., which may be thus enunciated: The eccentricity of the moon's orbit is dependent on the sun's disturbing force, and to the first approximation is equal to the ratio of the moon's period to the earth's period divided by the square root of 2. The value of $\frac{p}{52\,P}$ is 0.0529: the known eccentricity of the moon's orbit is 0.0518.

Cambridge Observatory, May 20, 1854.

ANNULAR ECLIPSE OF MAY 26.

Lieut. Maury has communicated a copy of a letter to the Secretary of the Navy, giving the following observations made at the Washington Observatory :—

	h.	m.	s.
Beginning, by Mr. Ferguson,	4	2	37.57
End, " "	6	27	26.46
" " Prof. Keith,	6	27	29.64

Mr. Ferguson observed with the large equatorial, and Prof. Keith with the west transit instrument, lifted from its Ys, and mounted on the reversing apparatus.

Dr. Van Pelt of Williamsville, N. Y., writes to the Editor :—

"The afternoon of the 26th was without a cloud. The leaves on the trees were without motion by the wind until the beginning of the eclipse, when a very gentle cool breeze from the west could be felt during the whole time. My clock was regulated by altitudes taken with a sextant, on the 20th, 22d, 24th, and 26th. I observed with a reconnoitring telescope of the power of 19, through a smoked object-glass. The following are my periods :—

	h.	m.	s.	
Beginning,	3	48	6	Mean Time Williamsville.
End,	6	14	59	

I could not see the edge of the moon's disc when off the sun. A slight roughness, no dark lines, the cusps expanded at the extreme points. The moon's disc was (lightly) agitated by coruscations. The illuminated band bordering the moon's disc was of a rose-color slightly tinged with yellow. I could see no luminous projections. There was a slight formation of dew."

Prof. Daniel Kirkwood, writing from Delaware College, May 27, says :—

"Our telescope, a reflector of 11 feet focus, revealed nothing specially important during the eclipse of yesterday. Perhaps, however, it may be proper to remark that the 'agitation at the edge of the moon's disc'— a tremulous or slightly waving motion — was distinctly noticed.

"The north pole of the magnetic needle moved westwards during the eclipse about 45. To-day the same needle during the same time has remained stationary."

Prof. Kirkwood also communicates his thermometric observations made in the sun and the shade at intervals of five minutes during the eclipse. These temperatures at $4^{h.}\ 10^{m.}$ were 89° and 78°; at $5^{h.}\ 40^{m.}$, 76° and 68°; at $6^{h.}\ 25^{m.}$, 92° and

70°. Want of space prevents the publication of the whole series.

Prof. JAMES CURLEY has also communicated the observations at Georgetown College Observatory. The last contact was observed by Prof. SESTINI with the equatorial, using a power of 25 or 30, in order to have the whole of the sun in the field of view. The time was determined with the meridian circle from the transit of the sun on the 26th, and after applying the necessary corrections was determined to be for the last contact $6^h\ 27^m\ 22^s.67$, Georgetown Mean Time. Lat. 38° 54′ 26″ N., Long. $5^h\ 8^m\ 18^s.2$ W. of Greenwich.

G.

OBSERVATIONS OF THE THIRD COMET OF 1853, MADE WITH THE SANTIAGO EQUATORIAL.

[Communicated by Lieutenant GILLISS.]

By DR. C. W. MOESTA,

DIRECTOR OF THE OBSERVATORY.

Date.	M. T. Greenwich.	No. of Obs.	Comparison-Star.	☄ — *		☄'s apparent		Hour Angle
				Δα	Δδ	α	δ	
1853.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″	h. m. s.
Sept. 16	21 47 43.6	3	(1)	+ 2 0.48	+8 0.4	10 16 33.87	—23 6 13.7	5 26 12.6
17	21 36 13.9	2	(2)	+13 50 79	+2 50.2	10 13 53.02	21 2 42.0	5 31 6.7
23	21 2 49.1	2	(3)	+ 30.55	—1 5.9	10 1 45.91	28 19 30.0	5 28 50.3
27	21 9 40.5	2	B. A. C. 3103	+ 6 32.24	— 19.7	9 56 17.93	30 23 19.4	5 0 43.8
28	21 20 43.0	3	(4)	— 4 43.89	+ 46.2	9 55 7.20	30 50 14.6	4 41 32.3
30	20 53 2.6	2	(5)	— 43.36	—7 39.0	9 53 1.26	31 44 16.1	5 2 18.3
Oct. 5	19 42 0.2	4	(6)	+ 1 27.16	+7 10.6	9 48 30.02	33 32 46.3	5 49 18.2
5	20 34 54.8	1	(7)	— 2 44.73	—2 2.1	9 18 28.67	33 33 53.0	4 56 13.6
7	19 30 43.4	9	Lc. 4065	— 1 24.11	+ 45.1	9 46 52.18	—34 13 24.1	5 51 6.0

Adopted Mean Places, 1853.0, *of Comparison-Stars.*

*	Mag.	α	δ	No. of Obs.	Authority.
		h. m s.	° ′ ″		
(1)	6	10 14 33.87	—22 58 20.0	5	Santiago Observations.
(2)	6½	10 0 2.48	23 59 57.2	3	" "
(3)	9	10 1 15.60	28 20 42.2	3	" "
B. A. C. 3103	6	9 19 45.86	30 23 46.8		British Association Catalogue.
(4)	10	9 59 51.28	30 50 5.5	4	Santiago Observations.
(5)	11	9 53 44.80	31 49 2.9	3	" "
(6)	8½	9 47 2.91	33 25 44.6	3	" "
(7)	10	9 51 13.45	33 36 4.0	3	" "
Lc. 4065	6½	9 48 13.29	—34 12 48.0	6	" "

NEW BOOKS.

1. *Washington Astronomical Observations.* — The Washington Observatory, under the Superintendence of Lieutenant MAURY has published the third volume of its Astronomical Observations, containing those made during the year 1847.

Appendix A contains a series of observations by Professor SESTINI of Georgetown College upon the Solar Spots between September 20 and November 6, 1850, accompanied by forty-four lithographic drawings in illustration.

Appendix B consists of observations on the Mississippi River at Memphis, Tennessee, by Mr. ROBERT A. MARR, United States Navy.

Appendix C is composed of an admirable series of tables for the reduction of the places of fixed stars, prepared by Professors COFFIN and HUBBARD. They are derived from BESSEL'S formulas, using the more recent values of the constants, as adopted in the American Astronomical Ephemeris (1855, p. 227).

2. *Memorie dell' Osservatorio dell' Universitá Gregoriana in Collegio Romano.*— Professor SECCHI prosecutes his observations at Rome with his accustomed zeal, and continues the publications of his annual volume.

3. *Observationes Eclipsis Solaris quæ erat die* XXVIII.

Julii, M DCCC LI. *calculatæ a* JOH. MORT AGARDH. Lundæ. 1853. — A valuable and extended discussion of the observations of the great total eclipse of 1851, according to the formulas of BESSEL. (*Astr. Untersuch.* II.)

4. LITTROW *Ueber das allgemeine Niveau der Meere. Bahnnähen zwischen den periodischen Gestirnen des Sonnensystems.* Two memoirs reprinted from the Proceedings of the Vienna Academy of Sciences.

G.

REMARKS BY THE EDITOR.

THE present number completes the third volume of this Journal. Many circumstances which it is unnecessary to detail have at times combined to impede the regularity of its publication; but it is trusted that its usefulness has not fallen short of the anticipations entertained at the time of its establishment, at the close of 1849. I am not without hope that steps may soon be taken to insure greater regularity for the period of its future continuance.

Demanding as it does no small expenditure of time, which can with difficulty be spared from regular and engrossing duties, a lenient judgment of its short-comings may with propriety be solicited. The large pecuniary outlay entailed upon the Editor, in spite of past liberality of lovers of astronomy in the United States, also renders the continuance of the *Astronomical Journal* a matter of serious embarrassment, while its cessation seems, especially at the present juncture, much to be deprecated. I shall therefore use every exertion to secure its continuance, and rely upon the coöperation of American astronomers, for whose aid it was originally established and upon whose aid it must still chiefly rely.

The most cordial thanks are due to my friend, Professor WINLOCK, for his aid in superintending the affairs of the Journal during my own unavoidable absence from home. Through his assistance alone it has been possible to secure its publication during two winters when official duties rendered my presence in distant parts of the country indispensable.

B. A. GOULD, JR.

Cambridge, June, 1854.

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Ceres,	①	*Parthenope,*	⑪	*Lutetia,*	㉑
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Juno,	③	*Egeria,*	⑬	*Thalia,*	㉓
Vesta,	④	*Irene,*	⑭	*Themis,*	㉔
Astrea,	⑤	*Eunomia,*	⑮	*Phocea,*	㉕
Hebe,	⑥	*Psyche,*	⑯	*Proserpina,*	㉖
Iris,	⑦	*Thetis,*	⑰	*Euterpe,*	㉗
Flora,	⑧	*Melpomene,*	⑱	*Bellona,*	㉘
Metis,	⑨	*Fortuna,*	⑲	*Amphitrite,*	㉙
Hygea,	⑩	*Massalia,*	⑳		

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THE
ASTRONOMICAL JOURNAL.
No. 73.

VOL. IV. **CAMBRIDGE, 1854, JULY 15.** **NO. 1.**

RESULTS OF ADDITIONAL INVESTIGATIONS RESPECTING THE TWO NUCLEI OF BIELA'S COMET.

By PROFESSOR J. S. HUBBARD,
OF THE WASHINGTON OBSERVATORY.

SINCE the completion of the investigations respecting Biela's comet, whose results are given in Nos. 56–60 of this Journal, I have resumed the study of the relative motions of the two nuclei, combining the observations in 1852, and those made at Pulkowa in 1846, with the materials previously used.

Assuming SANTINI's values of the perturbations from 1846 to 1852, (1) I obtained by a rough computation approximate values of $\Delta\mu$ and $\Delta\mu'$, and substituting these in Elements III. and B, (2) computed for 1852, and for each nucleus, an ephemeris sufficiently exact to serve for reducing and comparing the observations. In the reductions, I assumed for the comparison-stars, where given, the places determined by CHALLIS, (3) applying corrections to the places assumed by the observers in the same manner as in the previous investigations. The results are as follows: —

BERLIN. (*Preceding Nucleus.*) [*Astr. Nachr.*, XXXV. p. 246.]

M. T. Greenwich.	α	δ	C. — O. $\Delta\alpha$	C. — O. $\Delta\delta$	No. of Comp.
1852, Sept. 17.61078	141° 32′ 1″.3	+10° 51′ 0″.3	+4″.0	+10″.1	4
22.62528	147 29 57.6	+ 8 4 17.0	—9.3	— 2.2	2

CAMBRIDGE (ENG.). (*Following Nucleus.*) [*Astr. Nachr.*, XXXV. p. 327.]

M. T. Greenwich.	α	δ	C. — O. $\Delta\alpha$	C. — O. $\Delta\delta$	No. of Comp.
1852, Sept. 8.65876	130° 54′ 6″.4	+15° 24′ 35″.2	—70″.5	— 5″.6	1
16.65995	140 51 39.0	11 8 4.9	—43.6	+ 9.3	1
21.66099	146 48 53.8	8 22 17.7	— 7.4	+13.6	1
.66745	146 49 35.0	+ 8 21 58.6	—21.3	+19.7	7

PULKOWA. (*Preceding Nucleus.*) [*Astr. Nachr.*, XXXVII. p. 279.]

M. T. Greenwich.	α	δ	C. — O. $\Delta\alpha$	C. — O. $\Delta\delta$
1852, Sept. 18.55524	142° 40′ 30″.2	+10° 19′ 47″.0	—4″.2	+5″.3
20.57088	145 4 49.3	9 12 44.7	—1.9	+3.1
23.58304	148 36 49.0	7 32 17.7	—8.2	—0.6
25.57127	150 54 4.2	6 25 56.8	—2.8	+5.7
28.58623	154 18 27.2	+4 46 5.3	+2.6	+7.2

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(1) *Astr. Nachr.*, XXXII. p. 94.

(2) *Astron. Journ.*, III. pp. 90, 93.

(3) *Ibid.*, III. p. 80.

(*Following Nucleus.*)

M. T. Greenwich.	α	δ	C. — O.	
			$\Delta\alpha$	$\Delta\delta$
1852, Sept. 20.57723	145° 32′ 44″.1	+8° 58′ 22″.5	—26″.2	+11″.2
23.57073	149 2 30.5	7 18 52.6	—25.4	+ 8.2
25.58399	151 20 59.9	+6 11 55.1	—22.8	+17.9

ROME. (*Preceding Nucleus.*) [*Astr. Nachr.*, XXXV. pp. 90, 176, 191, 251.]

M. T. Greenwich.	α	δ	C. — O.		No. of Comp.
			$\Delta\alpha$	$\Delta\delta$	
1852, Sept. 15.63330	139° 7′ 50″.5	+11° 56′ 7″.5	—17″.7	+11″.8	5
19.62621	143 57 22.5	9 43 45.8	+ 0.9	+30.3	
20.63172	145 8 56.9	+ 9 10 19.8	+10.0	+26.4	

(*Following Nucleus.*)

M. T. Greenwich.	α	δ	C. — O.	
			$\Delta\alpha$	$\Delta\delta$
1852, Aug. 25.61814 (¹)	112° 22′ 30″.7	+21° 47′ 38″.1	—38″.4	+ 2″.6
.63348	112 23 28.5	21 46 55.9	—21.4	+23.6
27.61412	115 3 54.1	20 59 50.2	—10.1	+41.6
28.63454	116 25 49.5	20 35 22.3	—24.3	— 0.8
Sept. 1.63125	121 45 23.2	18 49 51.2	—25.8	+21.4
19.63211	144 25 27.4	9 29 35.3	—20.1	+22.3
20.64100	145 37 5.2	+ 8 56 17.4	—16.3	+ 9.1

The observations of the preceding nucleus, excluding the declinations obtained at Rome, give a very satisfactory normal. For the corresponding one of the other nucleus, I have taken only the Pulkowa observations, the right-ascensions obtained at Rome, September 19 and 20, and the second Cambridge observation of September 21, the only one at that place which depends on more than a single comparison. The two normals are, —

	M. T. Greenwich.	α	δ
Preceding Nucleus,	1852, Sept. 21.0	145° 35′ 18″.1	+8° 58′ 25″.0
Following Nucleus,	21.0	146 2 33.8	+8 44 16.0

The earlier observations at Rome, not included in these normals, will be of service in discussing the absolute motions of the nucleus to which they refer.

The foregoing results have been obtained upon the assumption, that what was known as the primary nucleus in 1846 is the same with the following in 1852. But upon farther consideration it appears that the question of identity is not so easily settled. Assuming $\Delta\mu = +0''.36334$, Elements III. give a very satisfactory representation of the observed places of the following nucleus; if we assume $\Delta\mu = +0''.51174$ the places of the preceding nucleus are equally well represented; and the results given in No. 60 of this Journal (²) show that the observations in 1846 are incapable of deciding within so narrow limits. Neither does a consideration of the physical phenomena furnish any more decisive evidence. We find that, notwithstanding the increased mutual distance of the two nuclei, their alternations of relative brilliancy were much greater than those noticed in 1846; so great, indeed, as for several days to amount to alternations of *actual visibility from day to day*, as will be seen by collating the dates of the above observations. We have then only the fact that the following comet was first found and oftenest observed; but the circumstances will hardly allow us to consider this as of sufficient weight to decide the question, and I have judged it safest to retain, at least for the present, the two hypotheses, —

I. That the primary nucleus in 1846 is identical with the preceding in 1852.

II. That it is identical with the following in 1852.

Returning now to 1846, I will first mention a remarkable circumstance, which requires for its due appreciation a knowledge of the great liability to change which the comets have manifested. The large residuals furnished by the observations at Cambridge (Eng.) on the 1st and 3d of December, 1845, as compared with those at Berlin on November 29 and December

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(¹) Observation of coincidence of the comet with a star.

(²) *Astron. Journ.*, III. pp. 90, 91.

1, early attracted my attention. Professor **Challis** kindly communicated the original notes from his observing-book, together with an additional observation of the coincidence of the comet with a very small star on the 3d of December; but these failed to furnish any explanation of the discrepancy. Impressed with the preconceived idea that the separation of the two nuclei had taken place subsequently to this date, and entirely unacquainted with the great variability which was afterwards as it were forced upon our notice, it was not until after the experience of 1852 that I seriously entertained the idea that these Cambridge observations did actually refer to the secondary nucleus. I then made the following comparisons with the original notes.

1845.	Cambridge Sid. Time.	α	$\Delta\alpha$ Primary.	$\Delta\alpha$ Secondary.	Cambridge Sid. Time.	δ	$\Delta\delta$ Primary.	$\Delta\delta$ Secondary.
	h. m. s.	° ′ ″	″	″	h. m. s.	° ′ ″	″	″
Dec. 1	23 20 58.9	337 32 4.4	+40.8	—15.8	23 12 17.4	3 13 34.6	—27.8	—41.4
	28 37.6	32 7.4	42.7	—13.9	32 34.4	56.2	(56.9)(1)	(70.5)
	40 5.8	31 46.4	71.2	+14.6	46 12.4	17.3	23.1	36.7
	0 3 55.4	32 8.9	63.9	+ 7.3	23 51 49.4	3 13 13.1	—21.0	—34.6
	7 45.6	337 32 2.4	+53.0	— 3.6			—24.0	—37.6
			+54.3	— 2.3				
Dec. 3	22 58 59.9	338 4 12.5	+31.2	—24.6	0 8 10.9	2 55 56.7	—22.4	—32.8
	0 57 2.4	5 0.5	65.9	+10.1	39 12.9	55 44.7	20.1	31.5
	1 2 48.6	338 5 15.5	+54.9	— 0.9	48 25.9	55 51.2	30.7	41.1
			+50.7	— 5.1	0 50 55.9	55 46.2	26.6	37.0
					1 7 56.9	2 55 31.2	—17.6	—28.0
							—23.5	—34.1

Still farther evidence is furnished by the observed coincidence of the comet with a small star on December 3. **Challis** found by observation that the minimum distance was 9″.4 at $7^{h.}\ 1^{m.}\ 14^{s.}.3$ mean time; and by computation with my Elements II. that the theoretical minimum for the primary nucleus was 22″ at $5^{h.}\ 44^{m.}$, I have found for the secondary nucleus 19″.5 at $6^{h.}\ 51^{m.}$. Since these things are so, and since the observations at Berlin on November 29 and December 2, agree entirely with the places of the primary nucleus, it seems to be fully established that we have here *in December*, 1845, *the first observations of the secondary nucleus, as well as the first instance of those singular alternations of light which were afterwards repeated in* 1852, *under similar circumstances of general faintness of both comets.* I have not, however, introduced the residuals of this date into the subsequent calculations, on account of the small number of observations on which they depend, and the still remaining uncertainty of the declinations, an uncertainty common to both hypotheses.

In No. 60 of this Journal, I have given a list of all the observations then received of the relative position of the two nuclei, and their comparisons with an ephemeris. I can now add the following valuable observations by **Otto Struve**, with the residuals furnished by the same comparison.

PULKOWA. [*Astr. Nachr.*, XXXVII. p. 282.]

M. T. Greenwich.	$\alpha' - \alpha$	$\delta' - \delta$	C. — O. $\Delta\alpha'$	C. — O. $\Delta\delta'$
	″	″	″	″
1846, Feb. 19.23	—158.5	+331.4	— 1.5	—6.2
21.25	177.6	351.1	+ 3.0	—4.7
Mar. 4.23	308.8	470.9	+ 3.8	—8.4
23.27	643.6	519.8	(—20.7)	—3.1
24.27	—677.0	+508.5	— 0.9	+1.1

I now arranged a new series of normals so as to furnish more points of comparison than before, and obtained the results given below; and after applying the above-mentioned corrections of μ, corresponding to hypotheses I. and II. respectively, computed for the dates of the normals the absolute places of the two nuclei for each hypothesis; the differences of these places compared with the normals gave the accompanying residuals.

It may also be mentioned here, that I have recomputed the perturbations of M and μ for the interval from 1846 to 1852, and found $\delta M = -2671''.83$, and $\delta\mu = -1''.40952$; results differing so little from **Santini**'s, as to justify my retaining his values for the variations of the other elements, at least in the discussion of relative motions.

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(1) "Very uncertain."

Normals.					Residuals. C. — O.			
					I.		II.	
M. T. Greenwich.	$\alpha' - \alpha$	No. of Obs.	$\delta' - \delta$	No. of Obs.	$\Delta(\alpha' - \alpha)$	$\Delta(\delta' - \delta)$	$\Delta(\alpha' - \alpha)$	$\Delta(\delta' - \delta)$
1846, Jan. 20.0	— 71″.5	10	+108″.1	9	— 3″.1	—1″.2	— 1″.4	+ 0″.8
28.0	84.8	12	148.2	12	+ 0.6	—0.4	+ 1.5	+ 1.2
Feb. 9.0	109.0	21	232.2	21	— 0.6	—0.6	— 0.1	+ 0.8
17.0	144.7	19	306.6	19	+ 0.8	—2.4	+ 1.1	— 1.0
25.0	208.1	14	388.9	13	+ 1.6	—1.2	+ 1.0	+ 0.1
March 5.0	314.6	15	473.2	10	— 0.1	—2.4	— 1.1	— 0.9
21.0	— 627.9	11	+530.5	12	+ 2.7	—1.9	— 0.3	— 0.4
1852, Sept. 21.0⁽¹⁾	±1635.7	10, 6	∓849.0	7, 3	—11.6	+5.9	+26.8	—18.6

As I decided to give to each of these normals the weight of unity, the coefficients for the equations of condition in 1846 may be obtained from those already given in No. 60 of this Journal, by dividing the latter by their weights also given there, and diminishing by unity the index of the log. coefficient of $\Delta 100\mu$. For the place in 1852, I have found the following: —

		ΔM	$\Delta \Omega_0$	$\Delta \omega_0$	Δi_0	$\Delta \varphi$	$\Delta 1000\mu$
1852, Sept. 21	R.A.	0.64684	9.62677	9.59673	9.16297	9.94102	1.03120
	Decl.	n0.36642	n8.74188	n9.32211	9.56441	n9.20606	n0.74984

The solution of the equations gives, —

	I.	II.
$d.\Delta M$	—0″.37	—0″.02
$d.\Delta \Omega_0$	+2.02	+3.74
$d.\Delta \omega_0$	+1.30	—2.00
$d.\Delta i_0$	—0.12	—0.60
$d.\Delta \varphi$	—0.28	+0.41
$d.\Delta \mu$	+ .00112	— .00272

	I.	II.
$M' - M$	—44″.60	—15″.35
$\Omega'_0 - \Omega_0$	— 4.88	—15.02
$\omega'_0 - \omega_0$	+ 6.78	+15.04
$i'_0 - i_0$	+ 0.77	— 0.37
$\varphi' - \varphi$	—17.80	+10.63
$\mu' - \mu$	+ .16898	— .13166

with the following residuals: —

	I.		II.	
	$\Delta\alpha.\cos\delta$	$\Delta\delta$	$\Delta\alpha.\cos\delta$	$\Delta\delta$
1845, Dec. 1.0	(—2″.8	—38″.3)	(+4″.0	—33″.6)
1846, Jan. 20.0	—1.7	— 0.6	—1.1	+ 0.4
28.0	+1.6	+ 0.4	+1.5	+ 0.9
Feb. 9.0	—0.2	+ 0.6	—0.5	+ 0.9
17.0	+0.7	— 0.9	+0.5	— 0.7
25.0	+0.9	+ 0.7	+0.3	+ 0.6
Mar. 5.0	—1.5	— 0.3	—1.6	— 0.4
21.0	+0.4	0.0	+1.1	+ 0.2
1852, Sept. 21.0	0.0	+ 0.1	—1.8	— 3.35

I. $[nn.6] = 11''.46$ $[vv] = 11''.48$

II. $[nn.6] = 24''.85$ $[vv] = 25''.21$

According to the above differences of elements, the periodic time of the secondary nucleus is, in the first hypothesis, $0^{d}.76$ less than that of the primary, — in the second hypothesis it is $0^{d}.59$ greater. The distances between the two nuclei at the dates of the several normals are approximately, —

	I.	II.
1845, Dec. 1	0.00123	0.00128
1846, Jan. 20	208	213
28	221	229
Feb. 9	238	242
17	237	240
25	0.00227	0.00230
1846, March 5	0.00212	0.00215
21	178	180
1852, Sept. 21	0.01934	0.01933

So that their greatest separation in 1846 was less than the moon's mean distance from the earth. This maximum distance was at the perihelion. Proceeding from this point in either direction, an easy calculation leads us to a point of nearest approach for each hypothesis; one, for the first, at —153°, the other, for the second, at +157° of true anomaly, — corresponding to 316° and 266° of heliocentric longitude respectively. At these points the distances are as small as 0.00016 and

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(¹) The upper sign corresponds to hypothesis I.; the lower to II.; the figures in the third and fifth columns for this date indicate the number of separate observations of the preceding and following nucleus, respectively.

0.00015. Another minimum occurs in the first case at +154°, and in the second at —155° of true anomaly, where the distances are 0.00078 and 0.00068. Since no other point of so near approach is to be found, there is very strong temptation to assume that the first hypothesis is correct, and that the separation of the nuclei must have occurred at a point near 316° of heliocentric longitude, corresponding to a time about 500 days before the perihelion. But it is still desirable to subject both hypotheses to the test of more extended investigations.

COMET-CIRCULAR.

A BRIGHT comet, having a tail about a degree in length, was discovered in the constellation *Lynx*, on the evening of June 24, by Mr. ROBERT VAN ARSDALE, at Newark, N. J.

It was observed on the meridian by the discoverer, who gives its position at the inferior culmination as

$$\alpha = 6^{h.}\ 4^{m.}\ 35^{s.} \qquad \delta = 61^\circ\ 2'$$

B. A. GOULD, JR.

Cambridge, 1854, *June* 26.

FROM A LETTER OF PROFESSOR ARGELANDER TO THE EDITOR.

Bonn, 1854, *June* 23.

I MUST send you to-day the elements of the new comet discovered by KLINKERFUES on the 4th of this month, of which I do not know whether you have heard. The comet is, to be sure, visible to the naked eye, but only as a star of the 6 or 5.6 magnitude, so that it might easily escape your notice.

My elements, based upon observations at Göttingen, June 5, and Bonn, June 11 and 17, are,—

T	June 22.0923 M. T. Berlin.
π	272° 59′ 6″
☊	347 42 24
i	71 16 58
Log q	9.81148
	Retrograde.

The similarity with the comet of 961 is very striking, and I find, that, if the two are identical, the comet must have been very much brighter in January, February, and March, 962, than at the present apparition. It is therefore very important to observe it as long as possible, and therefore all the more important that American Observatories should assume the labor. So I take the liberty of sending you an ephemeris for the month of July, which you will be so good as to distribute among American astronomers, should the comet not previously have been observed by you. It is for Berlin mean midnight.

	☄ α	☄ δ	Log. Δ
	h. m. s.	° ′ ″	
July 1	8 12 6.3	+56 54 2	0.03414
2	25 48.3	55 45 14	
2	38 13.3	54 32 36	0.04819
4	49 25.5	53 17 19	
5	8 59 31.9	52 9 23	0.06332
6	9 8 39.5	50 42 36	
7	16 54.4	49 24 41	0.07916
8	9 24 22.7	+48 7 10	
July 9	9 31 9.5	+46 50 28	0.09540
10	37 19.7	45 34 51	
11	42 57.3	44 20 37	0.11178
12	48 4.3	43 7 59	
13	52 49.9	41 57 2	0.12810
14	9 57 10.8	40 47 49	
15	10 1 11.6	39 40 24	0.14421
16	4 54.6	38 34 48	
17	8 21.6	37 31 1	0.15999
18	11 34.4	36 29 4	
19	14 34.5	35 28 54	0.17538
20	17 23.2	34 30 28	
21	20 1.7	33 33 43	0.19032
22	22 30.8	32 38 37	
23	24 51.5	31 45 8	0.20478
24	27 4.6	30 53 11	
25	29 10.7	30 2 44	0.21873
26	31 10.5	29 13 43	
27	33 4.7	28 26 5	0.23216
28	34 53.6	27 39 46	
29	36 37.8	26 54 43	0.24508
30	38 17.7	26 10 53	
31	10 39 53.5	+25 28 13	0.25749

The observations of the comet which I have are,—

1853.	M. T. Göttingen.	☄ α	☄ δ
	h. m. s.	h. m. s.	° ′ ″
June 5	13 37 27	2 5 23.25	+33 40 18.6
	45 19	24.22	43.9
1853.	M. T. Bonn.	☄ α	☄ δ
	h. m. s.	° ′ ″	° ′ ″
June 11	12 18 11.7	40 13 14.0	+43 57 58.8
17	13 32 21.0	56 51 21.9	+54 29 37.0

FR. ARGELANDER.

OBSERVATIONS OF CALLIOPE AND COMET 1854, III.

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By Mr. JAMES FERGUSON.

[Communicated by Lieutenant Maury. — Corrected for refraction.]

CALLIOPE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉒ − *		㉒'s apparent	
				Δα	Δδ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1854, April 13	9 14 4.5	6	B. Z. 502, 138	−2 32.31	+17 4.82	11 54 1.77	+19 54 55.01
May 6	10 12 30.3	3	" 456, 124	+1 46.31	− 8 45.75	11 44 20.97	18 33 1.71
15	8 51 1.9	6	" 456, 126	−2 2.37	− 0 14.96	11 43 39.06	17 39 32.80
19	10 31 0.4	5	" 456, 122	+2 9.56	+ 8 40.09	11 43 52.63	17 12 9.91
20	8 34 0.4	6	" 456, 122	+2 15.13	+ 2 14.60	11 43 58.19	17 5 44.54
21	8 49 55.4	5	" 456, 122	+2 22.78	− 5 10.88	11 44 5.77	16 58 19.18
	8 51 55.4	4	" 456, 121	+2 35.09	+ 1 35.61	11 44 6.05	+16 58 15.05

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 502, 138	7.8	11 56 20.58	+19 39 12.70	Bessel's Zones.
" 456, 124	9	11 42 21.22	18 43 7.87	
" 456, 126	8.9	11 45 28.04	17 41 8.39	
" 456, 122	7	11 41 29.81	17 4 49.89	
" 456, 121	7.8	11 41 17.71	+16 57 59.33	

COMET 1854, III.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	☄ − *		☄'s apparent	
				Δα	Δδ	α	δ
1854.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
June 25	10 49 38.2	8	(1)	+ 0 41.97	− 9 47.69	6 25 53.10	+60 58 43.46
26	10 9 1.6	4	B. A. C. 2312	−10 8.28	−17 3.34	6 46 23.15	60 43 59.92
	10 8 19.2	3	Rümker 2086	−10 16.06	−13 59.67	6 46 22.54	60 44 5.27
	10 19 42.6	3	Arg. Z. 93, 90	− 3 41.04	− 4 34.14	6 46 32.42	60 43 50.04
27	9 34 9.8	10	" 93, 119	− 2 56.20	+ 1 33.12	7 6 7.96	60 16 46.29
	9 33 19.2	8	" 93, 120	− 3 20.84	+ 6 39.71	7 6 7.31	60 16 45.35
30	9 49 41.3	4	" 96, 120	+ 6 13.66	−21 31.11	7 59 25.16	+57 49 30.64

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
(1)	(8)	6 24 49.63	+61 8 34.93	α from W. Equat.; δ W. Mural, Prof. Yarnall.
B. A. C. 2312	(6.7)	6 56 10.18	61 1 16.17	British Assoc. Catalogue and Madras Catalogue.
Rümker 2086	(6.7)	6 56 17.31	60 58 17.86	α Rümker; Madras; δ Mural, Prof. Yarnall.
Arg. Z. 93, 90	8.9	6 49 52.21	60 48 36.30	Argelander's Zones, and Washington Mural.
" 93, 119	8	7 8 43.26	60 15 29.78	Argelander's Zones.
" 93, 120	8.9	7 9 7.29	60 10 22.39	Argelander's Zones, and Rümker's Catalogue.
" 96, 120	7	7 52 52.78	+58 11 31.43	Radcliffe Observations, and Argelander's Zones.

OBSERVATIONS OF THE THIRD COMET OF 1854,

MADE AT CLOVERDEN

WITH THE FILAR-MICROMETER OF THE SHELBY EQUATORIAL.

By B. A. GOULD, Jr., and JOSEPH WINLOCK.

[Corrected for refraction.]

Date.	M. T. Cloverden.	Comparison-Star.	☄ — *				☄'s apparent		Observer.
			$\Delta\alpha$	No. of Comp.	$\Delta\delta$	No. of Comp.	α	δ	
1854.	h. m. s.		m. s.		′ ″		° ′ ″	° ′ ″	
June 27	9 36 53.9	*a*	+1 37.56	17	+7 17.9	6	106 27 40.5	+60 17 17.7	W.
	10 23 56.0	Argel. Z. 93, 120	—2 57.06	5	+6 12.6	2	106 37 31.4	60 16 17.0	W.
28	10 34 37.4	" 96, 87	—5 40.53	12	—1 23.0	8	111 23 42.9	59 36 12.4	G.
	14 48 8.8	" 96, 85	+0 56.36	11	+2 37.5	5	112 13 29.7	59 28 9.2	W.
July 1	9 42 33.8	" 188, 20	+2 35.75	3	—8 52.4	1	123 29 38.4	56 46 48.7	G.
	10 4 47.8	" 188, 19	+2 49.83	9	—7 32.3	5	123 32 53.1	56 45 40.3	G.
	10 41 21.5	" 83, 44	+7 14.10	3	—1 12.0	2	123 39 12.9	56 41 2.2	G.
3	9 34 49.2	*f*	—0 21.89	18	+2 7.7	11			G.
	13 44 32.1	*g*	—0 48.03	16	—5 8.1	6			G.
5	9 20 13.6	Argel. Z. 99, 39	+0 53.91	8	—7 58.6	3	135 9 43.5	51 53 22.0	G.
(1)	9 28 59.2	" 99, 40	+0 8.67	9	—1 1.1	7	135 14 45.5	+51 52 54.6	G.

Mean Places of Comparison-Stars for 1854.0.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
a	6.7	7 4 14.60	+60 9 53.1	Shelby Equatorial from A. Z. 93, 119; 93, 120.
Argel. Z. 93, 120	6	7 9 28.63	60 9 57.5	Mean, A. Z. 93, 120; 96, 58; and B. A. C. 2397.
" 96, 87	7.8	7 31 16.74	59 37 27.6	Argelander's Zones.
" 96, 85	8.9	7 27 58.97	59 25 24.1	" "
" 188, 20	9	8 11 23.82	56 55 32.2	" "
" 188, 19	9	8 11 22.72	56 53 3.7	" "
" 83, 44	7	8 7 23.99	56 42 5.5	Mean, Argel. Z. 83, 44; and Rümker 2452.
f	8.9			
g	8.9			
Argel. Z. 99, 39	9	8 59 45.61	52 1 11.0	Argelander's Zones.
" 99, 40	9.0	9 0 50.97	+51 53 46.7	" "

(1) Coincidence in α with Arg. Z. 99, 40, at 9h. 49m. 3s.3 M. T.

ELEMENTS OF THE COMET 1854, III.

By PROFESSOR B. PEIRCE.

THE accompanying elements are computed from the Cloverden observations of June 27, July 1, and 5.

Perihelion Passage, 1854, June 21d.842225, Clov. M. T.

$$\begin{array}{lrl} \Omega & 347^\circ\ 40'\ 48''.8 & \multirow{2}{*}{\Big\} \text{App. equinox, 1854, July 1.}} \\ \pi & 273\ \ 3\ 17.5 & \\ i & 71\ 19\ 16.1 & \\ \text{Log } q & 9.8117690 & \end{array}$$

Retrograde.

C. — O.

For middle place, — $\delta\lambda = +4''.1$ $\delta\beta = +21''.2$

SPECIAL ASTRONOMICAL PRIZE OF THE ST.-PETERSBURG ACADEMY.

At the request of Mr. Struve, the original programme of an astronomical prize proposed by the Imperial Academy of Sciences of St.-Petersburg is given below, since it is highly probable that many of our readers have not seen the number of the *Astronomische Nachrichten* in which it was printed. The editor has also been requested to mention that the Observatory at Pulkowa will devote attention to determining with the best attainable precision the places of those stars with which the comet has been compared at former apparitions; and that this work is already so far advanced that the greater part of these determinations will probably be published in the course of the present year.

G.

PROGRAMME D'UN PRIX D'ASTRONOMIE

PROPOSÉ PAR L'ACADÉMIE IMPÉRIALE DES SCIENCES DE ST.-PÉTERSBOURG DANS SA SÉANCE PUBLIQUE DU 29 DÉCEMBRE, 1853.

La division de la *comète de Biéla* en deux corps, apparemment séparés par un espace vide, est un événement unique dans les annales de l'astronomie. Cette catastrophe, qui eut lieu en 1846, presque sous les yeux des astronomes, a été suivie de changements extraordinaires dans les apparences et dans l'éclat des deux têtes. Des changements analogues se sont répétés lors du retour de la comète en 1852, malgré l'augmentation considérable de la distance réciproque des deux têtes. Ils accusent, à ce qui paraît, l'existence continuée d'une action mutuelle très remarquable. Toutes ces circonstances font de la comète de Biéla un objet du plus haut intérêt scientifique. A cela s'ajoute encore, qu'à l'occasion du dernier retour de la comète, en 1852, les positions observées ont énormément différé de l'éphéméride calculée d'avance par M. Santini, et qu'il n'est pas encore décidé, si les différences entre le calcul et l'observation doivent être attribuées uniquement à des imperfections du calcul, ou si elles ont été produites par des forces qui, lors de la division de la comète, ont effectué des changements brusques de l'orbite. Par cette raison, une recherche rigoureuse de l'orbite de cette comète a paru à l'Académie Impériale des Sciences digne d'être proposée au concours des astronomes et des géomètres, comme sujet d'un prix extraordinaire.

En considérant qu'à l'époque actuelle il est impossible de prévoir toutes les conséquences auxquelles mèneront les recherches, l'Académie ne croit pas devoir trop restreindre le problème à résoudre.

Le programme se résume ainsi dans les points suivants:

1. L'Académie demande une recherche rigoureuse des éléments de l'orbite que décrit le centre de gravité de la comète de Biéla; recherche qui doit être basée sur une discussion minutieuse de toutes les observations, obtenues dans les six apparitions observées entre 1772 et 1852, eu égard à toutes les perturbations perceptibles produites par les planètes.
2. Dans le cas où il n'y aurait pas moyen de représenter, d'une manière satisfaisante, par une seule orbite, toutes les observations, il faudra diviser la recherche en deux parties, dont l'une embrassera les observations faites depuis les temps les plus reculés jusqu'à l'epoque de la séparation des deux têtes; l'autre, les observations faites depuis cette époque jusqu'à présent.
3. La recherche doit être particulièrement dirigée sur les relations mutuelles des deux têtes, afin de déterminer, non seulement la position du centre de gravité entre les deux têtes, mais aussi, si c'est possible, les lois d'après lesquelles se sont effectués les changements de leurs positions relatives.
4. Le mémoire de concours devra être accompagné d'une éphéméride calculée d'avance pour le prochain retour de la comète en 1859.

Vu les longs et pénibles calculs que réclamera la solution complète de ce problème, l'Académie fixe au 1er août 1857 le terme pour lequel des mémoires destinés au concours devront être présentés. L'adjudication des prix se fera dans la séance publique de la même année.

Les mémoires de concours peuvent être écrits en russe, en latin, en français, en allemand, ou en anglais. Ils seront adressés, anonymes, mais munis d'une devise: *A l'Académie Impériale des Sciences de St.-Pétersbourg.* Un billet cacheté annexé, portant la même devise que le mémoire, renfermera le nom et l'adresse de l'auteur. Le mémoire couronné sera publié par l'Académie, et l'auteur en aura cinquante exemplaires à sa disposition. Les billets des mémoires noncouronnés seront brûlés, et les pièces mêmes tenues à la disposition des auteurs.

Le prix est fixé à 300 ducats de Hollande.

Il y a, en outre, un accessit de 150 ducats de Hollande.

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Elements of the Comet 1854, III., by Professor Benjamin Peirce.
Special Astronomical Prize of the St.-Petersburg Academy.

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THE

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QUANTITIES TO BE ADDED TO THE SOLAR EPHEMERIS OF THE AMERICAN NAUTICAL ALMANAC, TO OBTAIN THAT GIVEN BY HANSEN'S SOLAR TABLES WITH THE OBLIQUITY OF THE ECLIPTIC OF THE NAUTICAL ALMANAC.

COMPUTED BY PROFESSOR PEIRCE.

[Communicated by Lieutenant C. H. Davis, Superintendent Nautical Almanac.]

Date.	Right-Ascension.		Declination.		Longitude.		Latitude.	
	1855.	1856.	1855.	1856.	1855.	1856.	1855.	1856.
d.	s.	s.	″	″	″	″	″	″
Jan. 0	+0.15	+0.10	—1.99	—1.0	+2.2	+1.6	—0.4	+0.8
10	.17	.07	1.77	0.5	2.6	1.6	0.8	0.9
20	.21	.09	1.4	0.2	3.1	1.6	0.7	1.0
30	.24	.10	—0.9	—0.1	3.7	1.7	0.6	0.9
Feb. 9	.26	.11	0.0	+0.2	4.4	1.8	0.8	0.8
19	.28	.11	+0.9	0.4	5.0	1.8	0.4	0.6
Mar. 60	.31	.12	1.4	0.7	5.5	1.8	0.6	0.6
70	.33	.12	1.8	0.6	5.4	1.7	0.6	0.5
80	.33	.10	2.2	0.6	5.5	1.5	0.4	0.4
90	.32	.09	2.4	0.6	5.4	1.3	—0.3	0.4
100	.31	.06	2.5	0.7	5.2	1.3	0.0	0.3
110	.29	.07	2.4	0.8	5.0	1.4	+0.5	0.1
120	.28	.07	2.4	0.9	4.8	1.5	0.8	0.2
130	.27	.09	2.4	0.9	4.4	1.8	1.0	0.3
140	.26	.11	2.4	1.0	4.0	2.0	1.2	0.3
150	.26	.14	2.4	0.9	3.7	2.2	1.4	0.4
160	.25	.16	2.3	0.8	3.4	2.2	1.8	0.4
170	.23	.19	2.1	0.7	3.2	2.2	1.8	0.5
180	.23	.19	1.8	0.6	3.2	2.2	1.9	0.6
190	.22	.18	1.4	0.4	3.3	2.2	1.7	0.5
200	.20	.17	1.1	+0.2	3.3	2.1	1.5	0.6
210	.23	.15	0.8	0.0	3.2	2.0	1.4	0.7
220	.22	.12	0.4	0.0	3.1	1.8	1.0	0.6
230	.19	.09	+0.1	0.0	2.9	1.5	0.7	0.6
240	.18	.06	—0.2	0.0	2.7	1.2	0.6	0.6
250	.17	.05	0.4	0.0	2.5	0.8	0.4	0.8
260	.14	.04	0.6	—0.1	2.2	0.6	0.3	1.0
270	.13	.04	0.9	0.2	1.8	0.5	0.4	0.9
280	.12	.04	1.0	0.4	1.5	0.5	0.4	1.0
290	.10	.05	1.1	0.5	1.3	0.7	0.6	0.9
300	.08	.07	1.3	0.6	1.1	1.0	0.9	0.7
310	.07	.09	1.5	0.7	0.9	1.2	0.6	0.8
320	.05	.11	1.7	0.8	0.6	1.2	0.8	0.7
330	.03	.12	1.9	0.9	0.6	1.3	0.7	0.6
340	.05	.13	2.1	0.9	0.9	1.4	0.6	0.5
350	.09	.12	2.3	0.8	1.4	1.5	0.8	+0.1
360	.12	.09	2.0	0.7	1.6	1.5	0.9	—0.3
370	+0.09	+0.06	—1.6	—0.6	+1.6	+1.4	+0.8	—0.2

FROM A LETTER OF PROFESSOR SAWITSCH TO THE EDITOR.

St.-Petersburg, 1854, $\frac{\textit{May } 20}{\textit{June } 1}$.

Permit me to send you some of my planet observations with the Ertel meridian-circle. They are all of them at the time of transit over the meridian of St.-Petersburg.

OPPOSITION OF *JUPTIER.*

Date.	♃ α	Naut. Alm.	♃ δ	Naut. Alm.
	h. m. s.	s.	° ′ ″	″
1853, June 5	17 17 30.08	30.12	—22 33 2.8	5.7
7	16 24.50	24.40	32 4.9	11.6
8	15 51.52	51.43	31 39.3	44.3
11	14 12.68	12.43	30 15.7	20.2
12	17 13 39.48	39.44	—22 29 44.5	51.7

Mean correction of N. A. in α, +0ˢ.09 ; in δ, +5″.3.

The places given are for the center of the planet. The comparison-stars were η and 58 *Ophiuchi*, and their mean position for 1850 taken from the Catalogue of the British Association. The refraction and parallax were applied with all rigor, in these and in the following observations.

OPPOSITION OF *NEPTUNE.*

Date.	♆ α	Obs. — Eph.	♆ δ	Obs. — Eph.
	h. m. s.	s.	° ′ ″	
1853, Aug. 25	22 57 19.35	—0.64	—7 44 43.3	—1.5
26	57 13.45	0.56	45 22.7	—3.0
Sept. 2	56 31.38	0.11	49 12.4	+4.8
4	56 19.06	0.15	51 4.5	—0.6
5	56 12.56	0.51	51 12.2	+0.1
6	56 6.66	0.31	52 21.2	—0.4
8	55 54.34	0.46	53 33.6	+3.9
10	55 41.99	0.65	54 51.2	+2.0
11	55 36.33	0.14	55 31.8	—0.5
16	55 6.07	0.17	58 37.8	+1.0
17	55 0.05	0.26	59 17.5	—2.4
19	22 54 48.20	—0.27	—8 0 24.1	+3.9

Mean correction of the Ephemeris in α, —0″.35 ; in δ, +0″.6.

The comparison-stars were σ, λ, and φ *Aquarii*, from the British Association Catalogue.

QUADRATURE OF *NEPTUNE.*

Date.	♆ α	Obs. — Eph.	♆ δ	Obs. — Eph.
	h. m. s.	s.	° ′ ″	″
1853, Nov. 25	22 51 8.19	+0.42	—8 21 51.0	+1.9
26	51 8.86	0.58	21 46.8	+3.4
27	22 51 9.71	+0.90	—8 21 42.7	+5.0

Mean correction of the Ephemeris in α, +0ˢ.63 ; in δ, +3″.4.

The comparison-star was λ *Aquarii.*

The Ephemeris with which the observations are compared is that given in the Appendix to the Berlin *Astron. Jahrbuch* for 1855, and computed by Dr. Brünnow from Walker's Elements and Peirce's values for the perturbations.

You will find my little memoir upon astronomical and terrestrial refraction in the *Bulletin de l'Académie Impériale de St.-Pétersburg.* Allow me to communicate through your Journal also, the rule for computing the terrestrial refraction. This rule is deduced from Laplace's differential formula (*Méc. Cél.*, Tom. IV. Liv. X. p. 277) ; in the integration of which I have made use of the same hypothesis for the density of the various atmospheric strata which Bessel has used in constructing his tables of atmospheric refraction.

Let ϱ be the terrestrial refraction, expressed in seconds, i. e. the difference between the apparent and the true altitudes of the object observed ; h, this apparent altitude ; C the distance of the object from the observer, expressed in seconds ; b, the height of the mercury in the barometer reduced to zero of Réaumur's thermometer ; and t', the temperature of the external air at the place of observation, expressed in degrees of Réaumur. Then I find,

$$\varrho = 0.092 \left(\frac{b}{29}\right) C \cdot \frac{1}{\left[1 + 0.00474\,(t - 16)\right]^2} \cdot \frac{1}{(1 + 172\, s')^3}$$

in which $s' = \frac{2}{3} \sin C \,.\, tg\, (h + 0.3\, C)$.

This formula, derived solely from theoretical considerations, agrees very closely with the numerous observations made during the summer months both of the high Caucasian mountains and of very low objects also. The agreement is less satisfactory during the cold winter months. To satisfy both winter and summer observations the following formula must be used :—

$$\varrho = \frac{0.094 \left(\frac{6}{29}\right) \cdot C}{\left[1 + 0.00458\,(t - 16)\right]^{1.57}} \cdot \frac{1}{(1 + 172\, s')^3}.$$

These formulas hold for the terrestrial *normal refraction* so called, or for that condition of the atmosphere for which the terrestrial refraction attains for a period a certain constancy. This condition occurs in general twice a day, once in the early morning hours, and again during the afternoon, and may be easily recognized, with a telescope of sufficient magnifying power, by the steadiness of the object observed ; that is to say, by the absence of tremulousness.

A. SAWITSCH.

OBSERVATIONS OF THALIA, AMPHITRITE, COMET 1854, III., AND PARTHENOPE.

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

BY JAMES FERGUSON.

[Communicated by Lieutenant MAURY. — Corrected for refraction.]

THALIA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉓ — *		㉓'s apparent	
				Δα	Δδ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1854, May 21	9 40 10.97	10	Weisse XV. 210	—1 7.01	— 6 51.13	15 11 11.96	—13 33 8.41
	9 30 34.87	4	" 221	—1 48.94	—15 38.62	15 11 12.72	13 33 2.23
22	10 20 18.65	10	" 210	—2 5.72	— 7 7.57	15 10 13.25	13 33 21.88
27	10 23 50.87	10	" 79	—0 5.38	— 7 3.77	15 5 39.70	13 35 37.43
	10 25 52.84	9	" 91	—0 35.93	+ 4 11.60	15 5 40.10	13 35 33.28
June 1	11 7 17.76	12	Weisse XIV. 1150	+0 30.51	—13 0.46	15 1 32.31	13 39 25.11
3	10 59 45.58	6	" 1150	—1 0.08	—15 0.11	15 0 1.70	13 41 24.75
4	9 59 35.46	4	" 1150	—1 41.95	—16 6.71	14 59 19.85	—13 42 31.35

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XV. 210	9	15 12 4.22	—13 25 14.61	Weisse's Catalogue.
" 221	9	15 12 46.95	13 16 21.14	
" 79	7.8	15 5 30.34	13 27 29.26	
" 91	7	15 6 1.27	13 28 40.59	
Weisse XIV. 1150	7	15 0 47.00	—13 25 18.89	Weisse's Catalogue, and Madras Cat.

AMPHITRITE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉙ — *		㉙'s apparent	
				Δα	Δδ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1854, June 1	8 49 9.5	3	Weisse XII. 335	+2 46.43	—12 58.07	12 23 6.43	—6 58 28.32
		3	" 390	—0 40.10	— 7 7.10	12 23 6.86	6 58 32.26
	9 40 2.0	4	" 335	+2 36.47	—13 1.62	12 23 6.47	6 58 31.87
		4	" 390	—0 39.94	— 7 9.47	12 23 7.02	6 58 34.62
3	8 51 38.0	10	" 390	—0 16.21	— 9 56.81	12 23 30.73	7 1 21.85
4	9 1 47.2	10	" 390	—0 2.02	—11 33.07	12 23 44.91	7 2 58.08
12	9 31 25.5	7	" 494	—3 26.18	+ 9 19.92	12 26 23.56	7 20 29.20
	9 33 50.5	6	B. A. C. 4257	—5 19.96	— 8 53.84	12 26 23.55	7 20 31.47
15	9 11 33.4	8	Weisse XII. 494	—2 6.05	+ 0 53.67	12 27 43.67	7 28 54.46
20	9 17 0.5	9	" 494	—0 29.63	—15 26.28	12 30 19.32	7 45 14.86
	9 19 29.1	8	" 549	—2 49.69	— 6 44.37	12 30 19.45	7 45 14.18
July 2	9 6 7.8	12	" 668	—1 11.54	—10 4.62	12 38 19.89	8 35 6.34
12	8 36 0.4	6	" 803	—0 32.81	+12 4.32	12 46 43.16	9 26 34.59
15	8 41 14.6	6	" 803	+2 14.29	— 4 51.60	12 49 30.19	9 43 34.06
22	8 37 2.8	5	" 918	+2 38.18	— 3 20.03	12 56 23.20	—10 25 37.10

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XII. 335		12 20 16.833	—6 44 3.05	Weisse's Catalogue.
" 390		12 23 33.77	6 49 57.99	
" 494		12 29 36.59	7 28 22.30	
B. A. C. 4257		12 31 30.36	7 10 10.95	Rümker's Catalogue.
Weisse XII. 549	8	12 32 56.06	7 37 2.58	Weisse's and Rümker's Catalogue.
" 668		12 39 18.29	8 23 36.75	Weisse's Catalogue.
" 803	9	12 47 2.91	9 37 8.34	Weisse's Catalogue, and Lamont's Zones.
" 918	9	12 53 33.64	—10 20 45.78	Weisse's Catalogue.

COMET 1854, III.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	☄ — * Δα	☄ — * Δδ	☄'s apparent α	☄'s apparent δ
1854.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
June 25	10 49 38.2	8	(1)	+ 0 41.97	— 9 47.69	6 25 53.10	+60 58 43.46
26	10 9 1.6	4	B. A. C. 2312	—10 8.29	—17 3.34	6 46 23.15	60 43 59.92
	10 8 19.2	3	Rümker 2086	—10 16.06	—13 59.67	6 46 22.54	60 44 5.27
	10 19 42.6	3	Arg. Z. 93, 90	— 3 41.05	— 4 35.14	6 46 32.42	60 43 50.04
27	9 34 9.8	10	" 93, 119	— 2 56.20	+ 1 33.12	7 6 7.96	60 16 46.29
	9 33 19.2	8	" 93, 120	— 3 20.85	+ 6 39.71	7 6 7.31	60 16 45.35
30	9 49 41.4	4	" 96, 120	+ 6 13.66	—21 31.11	7 59 25.16	57 49 30.64
July 1	10 17 13.6	6	" 188, 25	— 0 32.47	—15 53.90	8 14 34.11	56 43 59.35
	10 41 9.2	4	" 188, 28	— 1 55.70	—22 4.12	8 14 47.99	56 42 52.06
2	10 55 17.2	4	" 83, 66	+ 6 35.48	—18 15.37	8 28 23.42	55 32 37.46
3	9 3 24.7	3	Σ Cat. Gen. 1063	— 8 59.24	— 6 41.71	8 39 38.40	54 25 22.33
		3	Arg. Z. 83, 91, 93	— 9 35.41	+ 4 37.74	8 39 38.24	54 25 15.24
6	9 6 14.8	5	" 190, 24	— 5 1.07	—19 11.86	9 9 42.88	50 35 2.51
	9 2 15.3	4	" 190, 23	— 5 5.21	—12 33.84	9 9 41.40	50 35 43.04
11	8 57 15.2	2	B. Z. 497, 20	+ 4 14.44	+ 2 3.20	9 43 36.66	44 14 57.36
12	9 30 24.9	4	" 454, 24	— 2 12.95	— 0 8.87	9 48 48.20	43 0 52.82
15	9 24 14.9	5	" 498, 6	+ 2 51.73	+12 41.33	10 1 46.28	39 34 23.67
		5	" 498, 7	+ 2 13.48	+ 5 43.01	10 1 46.26	39 34 20.71
16	9 0 48.5	5	B. A. C. 3468	+ 2 48.60	+23 3.49	10 5 21.52	38 30 22.24
18	9 56 36.3	2	" 3559	— 5 13.84	+12 30.66	10 12 4.97	36 22 40.14
20	8 33 28.9	10	" 3560	+ 0 10.40	— 4 10.24	10 17 42.37	34 28 13.84
27	8 51 16.3	7	B. Z. 526, 41	+ 1 5.45	+ 7 27.47	10 33 21.02	+28 24 38.57

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
(1)	8	6 24 49.63	+61 8 34.94	α Wash. Equat. ; δ Wash. Mural ; Prof. Yarnall.
B. A. C. 2312	6.7	6 56 10.18	61 1 16.17	British Assoc. Catalogue and Madras Catalogue.
Rümker 2086	6.7	6 56 17.31	60 58 17.86	Rümker's Catalogue.
Arg. Z. 93, 90	8.9	6 49 52.21	60 48 36.30	Argelander's Zones.
" 93, 119	8	7 8 43.26	60 15 29.79	"
" 93, 120	8.9	7 9 7.29	60 10 22.40	Argelander's Zones, and Rümker's Catalogue.
" 96, 120	7	7 52 52.78	58 11 31.43	Radcliffe Observations, and Argelander's Zones.
" 188, 25	9	8 14 48.45	57 0 28.75	Argelander's Zones.
" 188, 28	8.9	8 16 25.57	57 5 32.21	" "
" 83, 66	8.9	8 21 30.19	55 51 30.30	Σ Cat. Generalis 1003.
Σ Cat. Gen. 1063	8	8 48 20.54	54 32 51.10	Σ Cat. Generalis.
Arg. Z. 83, 91, 92	8	8 48 56.62	54 21 21.43	Argelander's Zones, and Rümker's Catalogue.
" 190, 24	7	9 14 27.86	50 55 4.86	Argelander's Zones.
" 190, 23	9	9 14 30.52	50 49 8.39	" "
B. Z. 497, 20	8	9 39 7.23	44 13 45.53	Bessel's Zones.
" 454, 24	7.8	9 50 46.91	43 2 0.69	
" 498, 6	8	9 58 40.21	39 22 43.57	
" 498, 7	9	9 59 18.48	39 29 38.94	
B. A. C. 3468	6	10 2 18.75	38 8 20.80	British Association Catalogue.
" 3559	6.7	10 17 4.95	36 11 14.20	
" 3560	6	10 17 18.21	31 33 29.30	British Association Catalogue, and Rümker.
B. Z. 526, 41	7	10 32 2.22	+28 18 19.42	Bessel's Zones.

PARTHENOPE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑪ — * Δα	⑪ — * Δδ	⑪'s apparent α	⑪'s apparent δ
1854.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
June 15	11 26 36.0	6	Arg. Z. 390, 13	—1 11.73	+2 13.11	16 38 57.64	—16 1 26.51
20	10 58 59.9	11	" 390, 5	+1 5.02	+0 6.69	16 34 34.80	16 4 37.07
July 1	11 22 26.8	2	B. A. C. 5516	+3 50.41	—1 29.12	16 26 39.48	16 19 3.93
2	9 59 49.9	5	" 5516	+3 18.21	—3 11.30	16 26 7.27	—16 20 48.78

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Arg. Z. 390, 13	(7.8)	16 39 52.75	—16 3 5.30	Argelander's Zones.
" 390, 5	(8.9)	16 33 14.20	16 4 6.87	" "
B. A. C. 5516	(5)	16 22 33.47	—16 16 54.03	B. A. Cat., and Argelander's Zones.

ON THE EPHEMERIS OF CERES FOR 1855.

[From a Report of E. Schubert to Lieutenant Davis, Superintendent Nautical Almanac.]

For this ephemeris I have used the new method of the variation of the coördinates, instead of that of the constants, — in the form given by Professor Encke in the *Astr. Nachr.*, No. 814, page 353, etc. I have chosen the equation for the fundamental plane because in this case the perturbations of x, y, and z obtained are simply to be added to these quantities in computing the ephemeris.

It is very advantageous, saving much time and labor, to compute at once the sum of the perturbations by ♃ and ♄. The process according to this new method is as follows. The first four X, Y, Z are computed with $\xi, \eta, \zeta = 0$; with the sums of ♃ and ♄, ΣX, &c., a preliminary table of double integration is formed, and approximate ξ, η, ζ are thus obtained. With these, then, the second terms, $\delta\, d^2 \xi = \frac{k^2}{r_0^3} \left\{ \left(1 - \frac{r_0^3}{r^3}\right) x - \xi \right\}$, etc., are computed. $\Sigma X + \delta\, d^2 \xi$ is now a mere approximate $\frac{d^2 \xi}{d t^2}$, and this substituted for ΣX, &c., in the preliminary table of integration, gives nearer approximations for ξ, η, ζ. The substitution must be repeated till ξ, η, ζ undergo no farther change. Two substitutions will generally suffice. With the exact $\frac{d^2 \xi}{d t^2}$, $\frac{d^2 \eta}{d t^2}$, and $\frac{d^2 \zeta}{d t^2}$, thus obtained, another and final table for integration is constructed.

As no perturbations of the radius-vector are obtained by this method, the pure elliptical radius-vector is given in the ephemeris. The true disturbed radius-vector is of no importance afterwards, and a rough approximation to log r suffices for computing the intensity of light. The perturbations of r can, however, be computed from those of the coördinates.

$$\delta r = \frac{x}{r}\,\xi + \frac{y}{r}\,\eta + \frac{z}{r}\,\zeta + \tfrac{1}{2}\,\frac{y^2 + z^2}{r^3}\,\xi^2 - \frac{x\,y}{r^3}\,\xi\,\eta - \frac{x\,z}{r^3}\,\xi\,\zeta + \tfrac{1}{2}\,\frac{x^2 + z^2}{r^3}\,\eta^2, \text{ \&c., \&c.}$$

If we do not care for a small inaccuracy in the eighth decimal, and that only when the perturbations are considerable, or if the computer has not at hand the table for log f, the second part of the calculation of the coefficients may be easily executed in the following manner proposed by myself. Professor Encke in his pamphlet "On a New Method," etc., arrives, p. 6, at the final equations (4) of the form

$$\frac{d^2 \xi}{d t^2} = m'\, k^2 \left(\frac{x' - x}{\varrho^3} - \frac{x'}{r'^3}\right) + \frac{k^2}{r_0^3}\left(3\,\frac{x_0}{r_0}\,\delta r - \xi\right).$$

Supposing now $\delta r = \frac{1}{r_0}\,(x_0\,\xi + y_0\,\eta + z_0\,\zeta)$, I write the second terms of the right-hand side in the form

$$\frac{k^2}{r_0^3} \left\{ x_0\, \frac{3}{r_0^2}\,(x_0\,\xi + y_0\,\eta + z_0\,\zeta) - \xi \right\}.$$

The quantity $\frac{3}{r_0^2}\,(x_0\,\xi + y_0\,\eta + z_0\,\zeta)$ is the same constant for the three equations. I call it c, and put in it $x_0 + \frac{1}{2}\,\xi$ for x_0, etc. For the factors x_0, y_0, z_0, I put x, y, z. If greater accuracy is required, r, the disturbed radius-vector, must be used.

The approximate ephemeris for the whole year is computed directly from 8 to 8 days, and interpolated from 4 to 4; that for the opposition is computed from 4 to 4, and interpolated from day to day. In the *Berlin Jahrbuch* the ephemerides of the asteroids for the opposition are given for about 40 days, but I do not think this extensive enough, and have computed therefore in the case of *Ceres* for three months, which will be more than sufficient. I feel quite sure that the ephemeris will prove to be very near the truth.

The opposition of *Ceres* in 1855 takes place October 30, 12h. 8m. 18s. M. T. Washington. Intensity of light = 0.869.

OBSERVATIONS OF THE THIRD COMET OF 1854,

MADE AT CLOVERDEN

WITH THE FILAR-MICROMETER OF THE SHELBY EQUATORIAL.

By B. A. GOULD, Jr. and JOSEPH WINLOCK.

[Corrected for refraction.]

The unfavorable weather has prevented the attainment of so full a series of observations as could be desired, and on several of the evenings on which the comet was observed the want of sufficient catalogues had prevented the recognition of the comparison-stars. These we hope to be able to give hereafter. As one or two errors occurred in the reduction of the observations in the last number, owing to the haste of preparation, these are republished in the present series.

Date.	M. T. Cloverden.	Comparison-Star.	☄ − *				☄'s apparent		Observer.
			Δα	No. of Comp.	Δδ	No. of Comp.	α	δ	
1854.	h. m. s.		m. s.		′ ″		° ′ ″	° ′ ″	
June 27	9 36 52.9	*a*	+ 1 37.50	17	+ 7 18.0	6	106 27 39.6	+60 17 17.8	W.
	10 27 37.4	Argel. Z. 93, 120	— 2 54.85	2	+ 6 9.1	1	106 38 4.6	60 16 13.5	W.
28	10 42 17.5	" 96, 87	— 5 29.47	10	— 1 41.9	8	111 26 28.8	59 35 53.5	G.
	14 48 8.3	" 96, 85	+ 0 56.24	8	+ 2 36.7	5	112 13 27.9	59 28 8.4	W.
July 1	10 3 8.7	" 188, 19	+ 2 49.53	10	— 7 32.8	4	123 32 48.6	56 45 39.8	G.
	10 39 36.1	" 83, 44	+ 7 9.67	3	+ 1 44.2	2	123 39 16.1	56 43 58.4	G.
	9 42 33.8	" 188, 20	+ 2 35.75	3	— 8 52.4	1	123 29 38.4	56 46 48.7	G.
3	13 43 2.0	*g*	— 0 48.70	16	— 4 58.9	6			
5	9 20 13.6	Argel. Z. 99, 39	+ 0 53.91	9	— 7 58.4	3	135 9 43.5	51 53 22.3	G.
(1)	9 27 26.1	" 99, 40	— 0 8.67	10	— 1 0.9	7	135 10 25.3	51 52 54.8	G.
8	9 0 5.3	" 101, 93	— 1 22.32	4	— 9 30.1	4	141 16 33.3	48 1 45.7	G.
	9 50 47.3	" 101, 76	+ 9 57.44	6	+ 1 25.7	2	141 20 16.5	47 58 56.7	G.
10	10 18 55.1	Lal. 19029	+ 3 52.76	13	+ 3 36.7	4	144 33 46.2	45 25 44.5	W.
17	9 50 20.0	β Leon. Min.	—10 33.98	8	— 1 58.3	4	152 12 55.6	37 25 23.7	G.
18	9 16 57.0	B. Z. 499, 87	— 0 47.23	9	+ 8 20.2	6	152 59 29.3	36 25 27.9	W.
19	9 26 45.3	" 499, 97	— 5 36.09	12	—11 26.1	5	153 44 39.7	35 25 14.5	W.
27	9 13 15.4	39 Leon. Min.	+ 1 4.79	7	+ 7 26.4	3	158 20 11.3	+28 24 38.1	G.

Assumed Mean Places of Comparison-Stars for 1854.0.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
a	6.7	7 4 14.60	+60 9 53.1	Shelby Equatorial from A. Z. 93, 119 ; 93, 120.
Argel. Z. 93, 120	6	7 9 28.63	60 9 57.5	Mean, A. Z. 93, 120 ; 96, 58 ; Br. Assoc. Cat. 2397.
" 96, 87	7.8	7 31 16.74	59 37 27.6	Argelander's Zones.
" 96, 85	8.9	7 27 58.97	59 25 24.1	" "
" 188, 19	9	8 11 22.72	56 53 3.7	" "
" 83, 44	7	8 7 23.99	56 42 5.5	Mean, Argelander's Zones 83, 44 ; and Rümker 2452.
" 99, 39	9	8 59 45.61	52 1 11.0	Argelander's Zones.
" 99, 40	9.0	9 0 50.97	51 53 46.1	" "
" 101, 93	8.9	9 26 28.96	48 11 6.3	" "
" 101, 76	8.9	9 15 24.12	47 57 21.8	" "
Lal. 19029	9	9 34 22.64	45 22 0.9	Red. Histoire Céleste.
β Leon. Min.	4.5	10 19 25.68	37 27 14.1	Mean, Rümker 3197 ; Greenwich 12-Year Cat. 888.
B. Z. 499, 87	8.9	10 12 45.31	36 17 0.2	Bessel's Zones.
" 499, 97	8	10 20 31.84	35 36 33.2	Mean, Bessel's Zones 491, 101 ; 499, 97.
39 Leon. Min.	6.7	10 32 16.01	+28 17 6.0	British Association Catalogue 3650.

(1) Coincidence in α with Argelander's Zones 99, 40, at 9h. 49m. 3s.3.

LETTER FROM PROFESSOR KEITH TO THE EDITOR.

Washington Observatory, 1854, *July* 28.

I SEND you the elements of an orbit for the III. Comet of 1854. The places used were those of the Bonn Observatory for June 11, and those of this Observatory for June 26 and July 11.

Perihelion Passage, June 21.7751.

$$\begin{array}{rl} \pi & 273^\circ\ 6'\ 52''.4 \\ \Omega & 347\ 40\ \ 8.0 \end{array}\Big\}\ \text{Mean equinox, 1854.0.}$$

$$\begin{array}{rl} i & 71\ 18\ 46.0 \\ \text{Log} \cos\varphi & 8.635714 \\ \text{Log}\ \ q & 9.811593 \end{array}$$

These elements give for the middle place :

$$\Delta\alpha\ 1''.5 \qquad\qquad \Delta\delta\ 1''.6$$

It may be worth while to add, that log $C \sin \omega\, Q$ and $(\omega + \sigma)$ of Gauss, being respectively 0.090111, and $-27^\circ\ 59'\ 56''.0$, $z = 71^\circ\ 9'\ 29''.2$ is easily found ; although $C\, Q \sin \omega$ does not come within the limit of Encke's Table.

REUEL KEITH.

OBSERVATION OF THE ANNULAR ECLIPSE OF MAY 26, IN THE SUBURBS OF OGDENSBURGH, N. Y.

Approximate Latitude 44° 41′.3 North. — Longitude estimated at $5^{h.}\ 2^{m.}\ 6^{s.}$ West of Greenwich.

By STEPHEN ALEXANDER, LL.D.,

PROFESSOR OF MATHEMATICS AND ASTRONOMY IN THE COLLEGE OF NEW JERSEY.

Ogdensburgh in St. Lawrence County, N. Y., was selected as the place of observation of the Annular Eclipse of the 26th of May last, because it presented the advantage of being the westernmost of all those stations near the line of the central eclipse which were at all readily accessible ; it being at once foreseen, that not only must the phenomena therefore occur in fact a very little earlier than at stations farther east, but also at an earlier period of the day as measured by the local time. In addition to this, it seemed not impossible that the western stations might be in the enjoyment of a clear sky, while the eastern stations, rather closely located in longitude, were perhaps to be all overshadowed by a coast-storm ; an anticipation which, to the disappointment of several well-prepared observers, was far too nearly realized.

I was assisted in my observations by two of my former pupils in the College of New Jersey, Messrs. William J. Gibson and Richard M. Strong, both of Albany, N. Y. Their presence with me was not only a matter of sincere personal gratification, but was important also, as we were together enabled to note some phenomena which might otherwise have escaped me, and they, by their aid, contributed not a little to the accurate observation of those which I might have noted if alone.

The actual station occupied by us, for the occasion, is situated about three quarters of a mile south, and as much west, of what may at present be designated as the middle of the village. It was an elevated and uninclosed spot, commanding a nearly unobstructed view on all sides, and thus including portions of the country on both sides of the river ; though we were at some little distance from the river itself.

Toward one side of the spot selected, and at some little distance from the road leading to it, the cellar of a house had been partly completed. In the middle of this cellar the owner of the locality had met with an unexpected obstruction in a protruding mass of rock, rising nearly to a level with the surface of the ground, and presenting at its upper surface an area of about ten feet long by six feet wide.[*] This afforded a support for the telescope unrivalled for firmness and yet sufficiently elevated, while the position at the same time was not a little sheltered from the influence of a brisk wind which prevailed until after the eclipse had begun. Some large trees scattered here and there afforded us, besides, very good supports for our thermometers, in positions sufficiently removed from the radiation of dry earth.

In addition to these various circumstances, we were throughout favored with a singularly clear sky : not the smallest cloud obscured the sun from the beginning to the end of the eclipse ; and sometimes no cloud could be discerned in any part of the heavens.

The latitude of the place of observation can only be approximately stated, the observations of altitudes being so completely extra-meridian as not to be well conditioned for the improvement of our knowledge of that element. We were restricted to observations such as these in consequence of the short time (not much more than twenty-four hours) to which we were limited, and the distance of our station from our lodgings. As, however, Ogdensburgh is quite near to the well-ascertained limit of 45° North, and in a region which has undergone the survey of a boundary commission, as well as otherwise, it is presumed that the error in the estimated latitude must be but small.

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[*] The rock bore the marks of an entirely unsuccessful attempt at blasting it, which had been made on the very day previous to that of the eclipse.

Our list of instruments included an achromatic telescope by Utschneider and Fraunhofer (being, it would seem, No. 22 of the catalogue published in No. 405 of the *Astronomische Nachrichten*); aperture of object-glass 37 lines German, or about $3\frac{1}{4}$ inches English, and its focal length 48 German, or about 51 English inches. One of the terrestrial eye-pieces was employed; and the view was, of course, *erect;* — the amplifying power, as per catalogue, being 57.

The aperture of the object-glass was reduced by capping to $1\frac{1}{8}$ inches, for most of the observations, the cap being brought close to the outside of the glass. Near the time of the end of the eclipse, the cap of larger aperture was substituted for this, the area exposed being fully four times as great.

My assistants were furnished with a spy-glass of $1\frac{1}{3}$ inches aperture and 14 inches focal length. Its steadiness was secured by a temporary fastening to the stand of an old reflector.

My series of screen-glasses included the respective tints of *white*, *greenish-yellow*, *green*, *blue*, *violet*, *deep-red*, and *orange* or ruddy.

The *yellow* and both of the *red* screens were single plates of glass; while the *violet* was made up of a *purple* and a *blue* plate; the *green*, of four *green* plates; the *white*, of four plates of "London smoke" or glass of a neutral tint (carefully assorted and adjusted experimentally); and the *blue*, of five blue plates of various intensity combined with a sixth of a neutral tint.

The spy-glass was provided with two screens, the one *red*, and the other *green;* the latter apparently compound.

The screens of the larger telescope had all been carefully tested, and successfully, for distinct vision and character of tint, with the sun near the meridian, before I left Princeton. The plates were believed to be well secured, in close contact, without strong pressure. I observed, however, that one of the blue series had become somewhat loosened before the observations were completed; but the distinctness of vision through it did not seem to be thereby at all essentially impaired.

While the field was, in every case, affected by the peculiar tint due to the tinted screen employed, and the same was in great measure true of the sun as seen through the two *red*, the *yellow*, and the *violet* screens, respectively, the *green* showed the sun himself *yellow* with slightly *greenish tinge*, and the *blue* gave him a fine bluish-white tint: through the *white* screen his freedom from any other tint was very unequivocal, and the field had very nearly the natural color of the sky, with its light of course enfeebled.

(*To be continued.*)

CORRIGENDA.

Vol. III. page 117, line —15, column 3, *for* $^{\circ\ \ \prime\ \ \prime\prime}$ *read* $^{\text{h. m. s.}}$
" " 179, " 18, " 8, " n " μ
" " 180, " 33, " 2, " 59.6 " 59.3
" " " " " " 4, " —1.9 " —2.2
" " " " 48, " 4, " —1.1 " —2.1
" " 182, " 12, " 8, " n " μ
" " 189, " 29, " 2, " signal-going, *read* signal-giving.

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OBSERVATION OF THE ANNULAR ECLIPSE OF MAY 26, IN THE SUBURBS OF OGDENSBURGH, N. Y.

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(*Continued from page* 16.)

We had, moreover, a two-day box chronometer by Arnold and Dent, and several other instruments for the observation of temperature, &c., notice of which will appear in their proper places.

Observations before the Beginning of the Eclipse.

The limb of the sun was for a while unsteady, but this disturbance was afterwards quieted, and it did not produce inconvenience in the observation of the first contact.

Search was made for the moon some little time before the computed moment of the beginning, screens of various tints being successively employed. A vague impression of the moon's being discernible was, however, all that could then be asserted; and the like may be said of any seeming agitation of the sun's limb previous to the first unequivocal contact.

In the observation of the beginning as well as of the formation of the annulus, the *white* screen-glass was made use of for the larger telescope; the rupture of the annulus was observed with the *blue*, and the end with the *green* screen.

Phenomena observable at the Beginning.

After the first unequivocal contact the motion of the moon seemed to be rather less rapid than is usual in such cases, as though there were some apparent *adhesion* of the limbs. Phenomenon not unequivocal. Screen *white*.

Distortion of the Cusps.

After the eclipse had considerably advanced, the northern cusp appeared, for a very short time, blunted; termination round. The time of this occurrence has failed to be recorded. Screen probably *white*.

Illuminated Band bordering the Moon's Disc.

h. m.
At 4 7 a narrow bright band; screen *blue*.
4 14 a wider band; screen *green*.
4 20 a little perceptible; screen *greenish-yellow*.

Then in succession,
Some perceptible; screen *deep-red*.
The same; screen *blue*.
Almost none; screen *violet*.
Scarcely any; screen *ruddy*.[*]

Narrow and Tinted Band of Light in the Projected Image of the Eclipsed Sun.

The image of the eclipsed sun was from time to time projected on a screen placed behind the eye-piece of the telescope.

The note with regard to it, at $4^{\mathrm{h.}}\ 43^{\mathrm{m.}}$, is, — Edge of the moon slightly prismatic, not so the other edge of the sun. Among the colors with which the edge of the moon's disc thus seemed to be bordered, at several trials, the red was far the most conspicuous: the border was a very narrow one. No such tinted border could be said to exist along the image of the sun's outer edge, either complementary to the former in its colors, or otherwise.

Polarization of the Direct Light of the Sun, or that from the Moon.

Some attempts to test this were made with a Savart's polariscope. No indication of polarization was seen in the case of the sun; but once or twice I seemed to see the dark bands arcoss the place of the moon's disc.

---

[*] At Philadelphia, Professors Frazer and Kendall "saw very distinctly the bright line of light bordering the limb of the moon during the whole of the eclipse, and satisfied themselves by changing the screen-glasses, and otherwise varying the observations, that it was real, and not a mere effect of contrast." (*Proceedings of the American Philosophical Society*, Vol. VI. p. 41.)

The phenomenon in question seems first to have been noticed by the author of this paper at Berlin, Maryland, during the progress of the eclipse of February 12, 1831.

By permission of Professor Loomis, I would also state, that, upon a personal inspection of the daguerreotype views of the eclipse taken by Mr. Root of New York, I found a bright border repeatedly present, occupying the place of that here described; which also is the position of the brighter part of the band seen *through* the telescope, and that of the "line of light" described by the Philadelphia observers.

Projection of the Moon's Disc beyond that of the Sun.

About 4$^{h.}$ 37$^{m.}$ the moon's disc seemed to be projected beyond that of the sun, as seen in an artificial horizon of linseed oil, through the small telescope of the sextant, the screen-glass of which was *yellow*. The phenomenon was not at the moment sought for, but made *itself* so far conspicuous as thereby to attract my attention.

The sun was then examined with the large telescope and *white* screen, and the same appearance discerned; but the arc projected seemed much shorter. It did not exceed some three or four degrees; whereas the impression derived from the glimpse obtained in the sextant-telescope was, that the arc was considerably more extensive than that, and the appearance more unequivocal in its character.*

At 4$^{h.}$ 39$^{m.}$ in large telescope with *violet* screen, arc faintly seen.
4 39½ with *blue* screen, seemed more distinct.
4 41 with *deep-red*, scarcely any.
4 45 with *white* screen, limb again seemed to be projected beyond the sun.

The (diminished) aperture of the large telescope was considerably greater than that of the small telescope of the sextant.

Color of the Moon's Disc.

This in general could not be distinguished from that of the rest of the field not occupied by the sun, except near the edge of that part of the moon's disc projected on that of the sun, where the tinge seemed to be darker than that of the other portions.

Phenomena preceding the Formation of the Annulus.—Rounded Termination of the Cusps, and Appearance of an Isolated Portion of the Sun's Disc.

As the cusps began to approach one another (slowly at first), they were bluntly terminated and rounded, and, as seen through the *white* screen, presented the appearance of the gradual flow of two columns of mercury in a tube of small diameter.

At 5$^{h.}$ 17$^{m.}$ 4$^{s.}$, a small rounded portion of the sun's disc (a "bead" or "drop") emerged; it being the only undoubted example of a seeming fragment having that special form that was seen at any time during the eclipse.

The appearance was not quite instantaneous; but closely resembled that of a star emerging *obliquely* after a *short* occultation: there being a semblance of a rolling over the edge of the moon's disc, and, it may be, some little intrusion rather than projection upon it; and the whole, as though the "drop" had come from beneath the surface of the moon and were issuing out of it rather than emerging from behind the disc. The "drop" had the neat roundness of the false disc of a white star, but I have the impression that it was somewhat elongated in a direction parallel to the edge of the moon's disc.* In its position and appearance it was very much like its representation in Fig. 1.†

The "drop" was soon caught by the advancing column (that terminated by the eastern cusp), and blended with it in its flow; as though both had really been constituted of brilliant and liquid metal, as they seemed to be. No manifest distinction between the absorbed "drop" and the other portions of the cusp was then noticed, or none, at least, has been recorded; for my attention could not be fixed upon its farther changes, as just about this time the cusps were advancing, with an increased rapidity, to complete the outline of the annulus, and with that occurred the phenomenon next in order; namely,

The first Appearance of Light uniting the Cusps.

The cusps, my notes state, were prolonged, "broken by roughnesses," when, at 5$^{h.}$ 17$^{m.}$ 27$^{s.}$.2, the edge of the moon's limb between the cusps was defined by a border, or rather trace, of white and misty light, like an exquisitely fine line drawn upon a black surface; such as is attempted to be represented in Fig. 2. At the same time, the tint of the moon's disc seemed to be discernible, distinguished as being *darker* than the rest of the field without and below the luminous border. This phase could not be an enduring one, but within the fourteen seconds which elapsed between the time when it was first perceived, and the sudden outburst of veritable sunlight, there became manifest

A Greater Extension onward from the Moon's Limb, and Variety in the Intensity of the Light uniting the Cusps.

This — bordering the convexity of the moon's disc, and with an intensity diminishing outward — appeared, as usual, like a rich aurora, or like a twilight of great intensity, seen, as it were, in miniature. (Fig. 3.)

---

* Ought we not to learn from this that such phenomena may, in the future, be best discerned by looking at the image by reflection (from a blackened glass plate perhaps), as is true of halos?

* The resemblance between these phenomena and those attendant upon the emersion of certain stars may, as far as it goes, serve to strengthen the supposition advanced by the author of this paper in May, 1843; namely, that a distorting action of the moon upon light is efficient after very much the same manner in both cases. (*Proceedings of the American Philosophical Society*, Vol III. p. 210.)

† A somewhat similar appearance would seem to have been noticed by Lieutenant-Colonel the BARON DE ROTTENBURG and Mr. FREDERICK J. ROWAN, at Kingston, C. W. It is stated, that "neither Mr. ROWAN nor BARON DE ROTTENBURG remarked any blunted appearance of the sun's cusps, nor did they see any portion of the moon's body throughout the eclipse, with the exception that, at 4$^{h.}$ 49$^{m.}$ 15$^{s.}$, a minute point of light, separated from the extremity of the eastern cusp of the sun by a very small distance, was first perceived on the dark body of the moon.

"Mr. ROWAN used a small telescope by TROUGHTON and SIMMS, attached to a transit theodolite; BARON DE ROTTENBURG, a telescope by DOLLOND, three and a quarter feet focal length, with an object-glass two and a quarter inches." (*Annular Eclipse of May* 26, *as observed in Canada.— Illustrated London News of June* 17, 1854.)

Extent and Color of the Light.

I have estimated that the arc of the moon's circumference bordered by the first trace of light (Fig. 2) did not differ much from 40°. That bordered by the brighter and broader tint (Fig. 3) must have been rather less; being diminished to about 35° just before the formation of the annulus began.

An imperfect estimate, made afterward, of the extension of the light in the direction of the sun's or the moon's radius outward would make it to have been about 40″ of a great circle of the sphere; though the outer and fainter portions may have reached about one third or one fourth as much farther; both conclusions being arrived at by a comparison of the breadth of the light with the computed breadth of the annulus.

As seen through the glasses of a neutral tint composing the *white* screen of the larger telescope, the light appeared white, with possibly some semblance of a yellow tint, as seen in comparison with the *intense* and pure white of the cusps.

Mr. Strong saw the light in his spy-glass, through the *red* screen.

Formation and Rupture of the Annulus, and Reappearance of the Light between the Cusps.

The length of the illuminated border between the cusps was reduced, as already stated, to about 35° of the moon's circumference, or it may be somewhat less, when the outbreak of the light of the sun itself took place in interrupted portions along the whole arc between the cusps, the disconnected parts having the form shown in Fig. 5. They were not like "beads" or "drops" but elongated and narrow, though most probably with rounded extremities.

Mr. Strong, who saw them in his spy-glass through the *red* screen, likened them to the fragments which we see when the thread of mercury in a thermometer tube is accidentally broken; a comparison aptly descriptive of the appearance in the larger telescope with the *white* screen. Mr. Gibson, who observed the analogous phenomenon at the rupture of the annulus with the *green* screen of the spy-glass, compared the seeming fragments to the lines traced by Morse's Electric Telegraph. In the larger telescope, as seen through the *blue* screen, the form of the fragments at the rupture was the same with that observed with the *white* screen at the formation of the annulus, and the arc bordered by them was, as it has seemed to me, not very different; though the observation of that particular was not so carefully attended to as in the other instance. The color of the sun's light, as seen through the *blue* screen, was *bluish-white.*

The outbreak of sunlight was very nearly simultaneous along the whole of the arc in question; though yet, it is probable, not strictly so. So rapid, however, was the process, that its successive changes could hardly be followed; though the fact that they were successive seemed to be indicated by a species of flash or coruscation which gave an indistinct impression of a motion along the line of the fragments, of themselves, like the progress of waves along the surface of a liquid, the *influence* travelling while the liquid is scarcely, if at all, transferred in the same direction.

Guided by this special phase of the phenomenon, I have been disposed to conclude that the emersion of the elongated fragments occupied but from six tenths to three quarters of a second; but this is a deduction, and not an estimate made at the time.

The emersion of the fragments and their running together seemed indeed like a single and very rapid process, but the time it occupied, if appreciable, failed to be noted. I found, indeed, that I could not settle upon any estimate more accurate than the nearest whole second, my attention being quite fully occupied by the various phenomena and their attendant circumstances, as already detailed; while the times of the other two phenomena represented in Figs. 1 and 2 were also to be borne in mind; — for the attention might not be diverted for a moment, nor the audible calling of the seconds, marked by the chronometer, interrupted.

Nearly the same remarks will apply to the observation of the rupture of the annulus and that of the light between the cusps which was visible through the *blue* screen for eleven seconds after the rupture.

It is earnestly to be wished, that the completion of the annulus may have been observed at some station near the very limit of the annular phase, where the changes of aspect were most probably sufficiently slow to have been separately noted, and the times of their occurrence also distinctly ascertained.*

Mr. Gibson saw the light, though not very distinctly, through the *green* screen of the spy-glass.

Mr. Strong's observed time of the formation of the annulus was one second earlier, and Mr. Gibson's observed time of the rupture two seconds later, than mine; though he regarded the time as noted by him as being very possibly in error in being somewhat too late.

Intensity of the Light uniting the Cusps.

This is in some measure indicated by the fact, that the light was visible for fourteen seconds before the formation of the annulus through the four plates of a *neutral tint* forming the *white* screen; and that it was also visible for twelve seconds after the rupture of the annulus, through the five plates of the blue screen, of which four were *blue* and one of a *neutral tint:* it being moreover borne in mind, that the aperture of the object-glass was reduced to 1⅛ inches, as heretofore stated.

---

* Kingston was situated about half-way between the line of the central eclipse and the extreme southern limit of the annular phase. The formation of the annulus must therefore have been somewhat *less* rapid than at Ogdensburgh, where the eclipse was nearly central; yet some of the same characteristics were noticed at the time of the formation of the annulus. "Baron de Rottenburg, a slight appearance of the light as it were running along the line of contact, but not with that degree of brilliancy or certainty which has been recorded on similar occasions." The color of the screen-glass of the telescope is not mentioned. (See *London Illustrated News of June* 17, 1854.)

It will moreover be noticed, that the observed duration of the light as seen through the *blue* screen after the rupture is *less* than that of the light seen through the *white* screen before the formation of the annulus; although after the rupture attention could be fixed upon the light until it disappeared, whereas before the formation the light must already have shone out when it arrested attention as it did; though as yet but beginning to be perceptible in the form already described, and which is represented in Fig. 2. The blue screen, in fact, exhibits a darker field, but the result is also not inconsistent with what has heretofore been stated; namely, that the light before the formation of the annulus had possibly a slight tinge of *yellow*.

Appearance of the Dark Lines of BAILY.

Of the beads or drops there was but one undoubted example, as has already been intimated; but while these were otherwise wanting, the intervals between the elongated fragments both at the formation and the rupture of the annulus would seem to *resemble* the dark lines, though on a reduced scale with respect to their length.

Indeed, the action upon the border light of the sun seemed to be less intense in some respects than usual; less so, pretty manifestly, than in the case of the eclipse of February, 1831, as I saw it through a *red* screen and with a power of about 80 at Berlin in Maryland; and possibly also less so than in the other instance witnessed by me at Princeton in September, 1838, when the same telescope was employed as in 1854, but with its full aperture, a lower power, and a *greenish-yellow* screen-glass.[*]

Breadth of the Annulus at the Place of its First Formation, and that of its Earliest Rupture.

No distinction was noted between the parts formed from the elongated fragments and the other portions when they were all united in the completed annulus; nor did the portion of the annulus thus completed appear sensibly narrower than the fragments had been, — contrary to what seemed to me to be the case in 1831; but I do not feel assured that no minute changes may have taken place which were unnoticed among the many other things requiring attention: yet no special phenomena were noted immediately previous to the rupture, concerning which the record in my minutes is "ring broken into" fragments, with the notes of the observed time.

Observations during the Existence of the Annulus.

The shadows of several small ivory balls were examined. The umbra appeared very dark and its outline sharp; and even the outline of the penumbra was sharply defined. The tint of the penumbra seemed to be rather bluish, and with its very dark central circle afforded itself no bad picture of an annular eclipse. Unfortunately none of the balls had been placed far enough from the screen, to obtain a shadow without a central spot; and there was not time for any other than a mere hurried look.

A glimpse of the annulus through the small telescope of the sextant showed it complete, but enlarged by *irradiation*.

As seen in the large telescope, my impression is that the annulus was somewhat narrower on the side toward the *southern* limb. It is probable that the centre of the shadow passed somewhat south of Ogdensburgh, and the annulus as shown in Fig. 1 is a little narrower on the left and below the centre; but its form as there exhibited is so far a matter of deduction, and not of observation.

The *roughness* of the moon's limb was, as it has seemed to me, rather more distinctly visible at this time (screen probably *blue*); this was especially true of its southeastern portion.[*]

As seen through the *blue* screen, the *color* of the middle of the moon's disc seemed rather to be tinted with the color of the screen, while the edges of the disc were dark.

I did not attempt to use either the filar-micrometer or the polariscope during the existence of the annular phenomena; though I was furnished with both. The attempt to have done so, at a station where the changes were so rapid, might very possibly have been attended with no success, and then the other observations appropriate to that time must have been neglected. A greater number of observers, all armed with suitable optical power, might very properly have so divided their labors as to have found a place for observations such as these.

End of the Eclipse.

For the observation of this, I considerably enlarged the aperture of the telescope, and made use of the *green* screen. The edge of the sun's limb showed itself with an unhoped-for steadiness at an altitude so low, and its definition in the telescope was admirable. The observed time of the end was $6^{h}\ 27^{m}\ 44^{s}.1$. Something like an *adhesion*, or at least a retarded motion, seemed to be noticeable; but the phenomenon was, I think, not so decided as a similar one which I observed at Princeton, through a *yellow* screen, with the same telescope, at the end of the eclipse of May, 1836.

Mr. GIBSON made use of the *violet* screen of the larger telescope; and the end as observed by him in the spy-glass took place 1½ seconds earlier than the other observation.

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[*] See also remarks of BARON DE ROTTENBURG already quoted.

[*] The edge of the moon during this eclipse appeared to me far less ragged than usual. "The irregular prominences on the moon's limb were seen by most or all of the" Philadelphia "observers." The observers at Kingston saw the moon's limb slightly serrated in moving over the sun's, the greatest extent of inequality being towards the extremity of the eastern limb. (*Proceedings of the American Philosophical Society*, Vol. VI. p. 41; also *London Illustrated News of June* 17.)

Times of Occurrence of the Principal Phenomena.

These will here be recapitulated and arranged as follows: —

	h. m. s.	
Beginning of the eclipse,	4 3 4.6	Alexander, (screen *white*).
Appearance of an isolated "drop" or "bead,"	5 17 4.4	" "
First trace of light between the cusps,	5 17 27.4	" "
Formation of the annulus,	5 17 40.4	Strong, (screen *red*).
	5 17 41.4	Alexander, (screen *white*).
Rupture of the annulus,	5 21 31.4	Alexander, (screen *blue*).
	5 21 33.4	Gibson, (screen *green*).
Disappearance of light between the cusps,	5 21 42.4	Alexander, (screen *blue*).
End of the eclipse,	6 27 42.6	Gibson, (screen *violet*).
	6 27 44.1	Alexander, (screen *green*).
Duration of the annulus as observed in the larger telescope,	0 3 50.0	
Duration of the eclipse,	2 24 39.5	

Appearance of the Moon after the End of the Eclipse.

A *semblance* of this is noted as having been seen with

	h. m.
The *violet* screen, at	6 29;
The *white* screen, at	6 31;
The *greenish-yellow*, the *green*, and the *white* (with a lower power),	about 6 48.

In none of these instances, however, was the appearance unequivocal.

Temperature in the Sun and in the Shade.

Two very neatly constructed thermometers, of French manufacture, with small spherical bulbs, were exposed to the sun; the one having its bulb carefully blackened by smoking it. One of another pair was unfortunately broken, and I supplied myself with a pair of common thermometers, one of which was placed in the shade, and the other used, in comparison with it, in noting the dew-point. The observations were mostly made by Mr. Strong. The scale is that of Fahrenheit.

Time.	Thermometer in the Sun.		Thermometer in the Shade.
	Bulb Coated.	Bulb Uncoated.	
Not noted, but near to the *Beginning of the Eclipse,*	81	75	
h. m.			
4 9	—	—	71
13	79	74	
15	—	—	71
27	78	74	70
37	76	73	69
44	77	73	68¾
57	75	72	68½
5 6	72½	70½	67½
Annular Eclipse.			
5 24	69	67½	65
32	70½	68½	65
47	73	69	65
57	74	70	66
6 12	76	71	65
End of the Eclipse.	—	—	—
h. m.			
6 31	77	71	65
47	73	68	64

Observations on the Dew-Point made by Mr. Gibson.

The dew-point was approximately ascertained by introducing small pieces of ice into a silver tumbler containing the water into which the thermometer was plunged, until the dew appeared upon the outside. Incidental circumstances and our other engagements did not well admit of a better arrangement. The results may be regarded as exhibiting an approximation to the hygrometric state of the atmosphere, but are not sufficiently accurate to mark with much exactness the extent of its variations.

Time.	Thermometer in the Shade.	Dew-Point.
Beginning of the Eclipse.		
h. m.		
4 27	70	45½
5 3	68	50
Annular Eclipse.		
5 29	65	45
6 2	66	44
End of the Eclipse.		
6 37	65	40 (unsatisfactory.)
6 42	64	42

When the eclipse was very considerable, the sensation produced was not only that of a decrease of temperature, but also that of an increase of moisture. It seemed as if the shadow must be that of a great rain-cloud.*

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* A little girl was overheard asking her brother to go home, as she feared that it would rain. Here, at Princeton, about the time of greatest obscuration, an individual was seen walking with an umbrella raised, as a defence against an approaching shower; though the sky was very clear.

Polarization of the Light of the Atmosphere.

Savart's polariscope showed the colored bands whenever tried during the progress of the eclipse; and when the visible surface of the sun was much reduced, they appeared with unwonted beauty and distinctness. The distance from the sun of the point in the sky around which the bands were most conspicuous, as estimated from time to time, seemed to be as follows: —

About the time of the *Beginning of the Eclipse*.	180°
At 4h. 47m.	90
4 57	130
Annular Eclipse.	
5 47	110
6 2	118
6 20	75
End of the Eclipse.	
6 34	118
6 52	120

Tint of the Sky, and Coloring of the Landscape.

The Kingston observers, in their account of the eclipse already quoted say: "At the period of greatest obscuration, the appearance of the landscape immediately under the sun was lurid, and seemed as if viewed through glasses of a neutral tint. The obscuration was very palpable, and quite different from the ordinary shades of evening."

This description conveys a just idea of the appearance at Ogdensburgh. To reproduce the appearance both in the sky and in the landscape, they should be viewed through a plate of "London smoke" having itself a subdued tint of green. This will very well show what was the state of things when the obscurity at first became "palpable," and a view through two rather dark plates of the same material will give a very good idea of the appearance at the time of greatest obscuration.

In any large eclipse of the sun, where the sky is clear, the peculiar tint exhibited is an approximation to that lurid *bottle-green* which shows itself during the *total* eclipse of that luminary; such, at least, as I observed in Georgia at the time of the total eclipse of November 30, 1834. At Ogdensburgh, the tint of *lurid green* commingled with *blue* overspread both sky and landscape on all sides, and was especially conspicuous as it fell upon the rising ground on the Canadian side of the river. It of course deepened in intensity as the eclipse advanced, as has already been intimated.

(*To be continued.*)

THIRTIETH ASTEROID.

THE *Monthly Notices* of the Astronomical Society of London, Vol. XIV. No. 8, announce that another asteroid was discovered by Mr. HIND on the 22d July, at $11^{h.}$ $25^{m.}$, at Mr. BISHOP's Observatory in Regent's Park. The observations given are as follows: —

1854.	London M. T.	α	N. P. D.
	h. m. s.	h. m. s.	° ′ ″
July 22	11 56 55	21 9 50.7	106 20 26 ::
	13 9 29	9 48.4	20 45.5
	13 40 47	9 47.7	20 50.2
23	10 46 52	21 9 1.3	106 23 13.7

The planet appeared of the 9.10 magnitude.

In the *Astron. Nachr.*, No. 915, p. 48, is an observation by Mr. LUTHER at Bilk.

	M. T. Bilk.	α	δ
	h. m. s.	° ′ ″	° ′ ″
July 26	12 20 29.4	316 33 15.7	—16 31 52.3

THIRTY-FIRST ASTEROID.

A NEW asteroid was discovered near *Egeria* on the 1st instant by Mr. FERGUSON at the Washington Observatory. On the 2d, it preceded *Egeria* 24^{s}, and was 52″ farther north, nearly equaling it in brightness.

Mr. FERGUSON has communicated the following observations: —

Date.	Washington M. T.	No. of Comp.	*	Planet — Star. Δα	Planet — Star. Δδ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1854, Sept. 2	10 59 2.5	4	B. A. C. 598	+1 37.02	—11 6.60	1 52 13.35	—2 57 12.1
	12 1 2.1	5	"	+1 35.68	—11 3.34	52 12.01	57 8.9
	13 31 6.6	3	"	+1 34.40	—10 57.50	52 10.73	57 3.5
6	15 38 49.5	12	"	—0 10.24	— 7 21.66	50 26.38	53 26.9
	16 30 54.4	3	"	—0 11.56	— 7 18.34	50 25.07	53 23.6
10	16 19 16.5	7	"	—2 18.28	— 4 8.87	1 48 18.30	—2 50 13.9

Adopted Mean Place for 1850.0 *of Comparison-Star.*

*	α	δ	Authority.
	h. m. s.	° ′ ″	
B. A. C. 598	1 50 22.17	—2 47 34.72	α, B. A. Catal.; δ Prof. Yarnall, Mural.

The planet has also been observed at Cloverden as follows:—

1854.	Cloverden M. T.	No. of Comp.	*	Planet — Star.		α	δ	Obs.
				Δα	Δδ			
	h. m. s.			m. s.	′ ″	° ′ ″	° ′ ″	
Sept. 12	13 34 28.1	5	Weisse I. 808	+1 59.99	—4 1.3	26 47 53.8	—2 48 45.0	G.
	"	5	" 891	—3 25.35	—2 39.0	26 47 48.4	—2 48 46.7	G.
	11 56 12.5	4	" 808	—1 22.62	—0 23.4	25 57 16.1	—2 45 7.3	W.
17	12 49 18.3	7	" 773	+0 32.60	+1 53.1	25 56 50.9	—2 45 5.2	W.

Adopted Mean Places for 1854.0 *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse I. 773	8.9	1 43 12.36	—2 47 16.9	Weisse's Catalogue.
" 808	8	1 45 9.27	—2 45 2.5	" "
" 894	7	1 50 34.33	—2 46 26.5	Greenwich Twelve-Year Catalogue.

Professor Keith has computed the following elements from the Washington observations of September 2, 6, and 10. They satisfy the middle place perfectly.

Mean Equinox, 1854.0. Epoch, Sept. 2.721 Greenwich M. T.

M	13° 36′ 33″.3
π	352 5 50.6
☊	33 29 21.7
i	22 39 13.6
φ	4 22 30.2
Log a	0.469530
" μ	2.845712

LETTER FROM PROFESSOR KEITH TO THE EDITOR.

Observatory, Washington, D. C., 1854, *September* 2.

I have computed the following hyperbolic elements for the comet of June and July; the first set from the Göttingen observations of June 5, and normal places for June 26 and July 18; the second, from the same first place and normal places for July 1 and 27.

Perihelion Passage, M. T. Greenwich,		June 22d.00334	22d.00317
☊	Mean equinox, 1854.0,	347° 40′ 17″.8	347° 39′ 58″.7
π		273 4 11.4	273 4 6.4
i		71 20 28.6	71 19 44.4
Log q		9.811731	9.811721
Log tang ψ		8.717069	8.473421

Their agreement with each other is, I think, sufficient to show that the present orbit cannot be reconciled with the appearance of the comet in A. D. 961.

REUEL KEITH.

LETTER FROM PROFESSOR AIRY TO THE EDITOR.

Royal Observatory, *Greenwich*, 1854, *August* 15.

I AM delighted to see Professor LOOMIS's discussion of the Greenwich Catalogues in the *Astronomical Journal*, Vol. III. No. 23. In regard to the two stars which Professor LOOMIS especially indicates as exhibiting some anomalies, permit me to offer the following remarks.

B. A. C. 5060. φ^2 *Lupi.*

No error has been found in the reduction of the observations of this star. But the star is only 2½° above the horizon of Greenwich; most of the observations are marked "very faint," or "extremely faint," and the differences of temperature are so great as seriously to affect the refractions. These circumstances appear sufficient to explain the discordance of the catalogued places.

B. A. C. 5845. ν *Serpentis.*

An error of 10″ was committed in applying the refraction on 1836, July 4. In the Greenwich Observations, 1836, page 29, in the seconds of N. P. D., for 22″.72, read 32″.72; page 73, for 15″.87, read 25″.87; page 88, for 17″.02, read 27″.02. In the Greenwich Catalogue of 1439, stars, page 49, and the Greenwich Twelve-Year Catalogue, page (cxli.), for 36″.99, read 41″.99. This correction completely removes the anomaly pointed out by Professor LOOMIS.

G. B. AIRY.

NEW WORKS.

Tables du Soleil exécutées d'apres les Ordres de la Société Royale des Sciences de Copenhague, par MM. P. A. HANSEN *et* C. F. R. OLUFSEN. 4to. Copenhagen. pp. 165. — This earnestly and long expected work, although bearing the date 1853, has but very recently reached this side of the Atlantic. The tables are founded upon the totality of the observations at Greenwich and Königsberg, and the authors promise an account of the calculations in a separate memoir.

The chief peculiarities of the arrangement are, — first, that the right-ascensions and declinations may be immediately taken out with the same facility as longitudes and latitudes, and the onerous transformation of co-ordinates required by previous tables thus avoided; and secondly, that all the perturbations in longitude, and those in latitude and radius-vector, so far as possible, are to be applied to the argument, or what is equivalent, to the time.

The constants for the luni-solar precession and for the obliquity of the ecliptic are BESSEL's, Mr. OLUFSEN's investigations having confirmed him in the adoption of this value of the latter, which differs from PETERS's at present by about half a second of arc.

In fullness and completeness, in elegance and convenience of arrangement, and in facility for interpolation, these tables seem to leave but little to be desired, and they sharpen the eager desire universally felt by astronomers, that the expected lunar tables to which Professor HANSEN has devoted such unwearied care and labor may soon be given to the world. It would probably be no over-statement to claim that by these tables the labor of computing a solar ephemeris is abridged by at least one half. Whether the peculiar arrangement by which the perturbations are applied to the argument prove of as much advantage in the computation of ephemerides as in that of single places of the sun, is a question which only experience can decide. In some respects the rapidity of interpolation would seem to be facilitated by the use of successive arguments differing from one another only by integers.

The table of arguments extends from the year 1750 to 1900; but an auxiliary table furnishes the quantities which must be added to the numbers deduced for the years 1800 to 1899, to obtain the values for the corresponding years in the twenty-six previous and four subsequent centuries.

It may be well to append a few *Errata* not given in the published list.

Page 59, *for* Arg. XVI., *read* Arg. XIV.
" 97, Arg. vert. 235 Arg. hor. 0.7 *for* 15′, *read* 14′.
" 97, " " 235 " " 0.8 " 21′, " 20′.
" 97, " " 235 " " 0.9 " 27′, " 26′.
" 127, " " 311 " " 0.7 " 5′, " 3′.
" 162, col. 3, move all decimal points one place to the left.
" 157, Arg. vert. 21, *for* 00.57, *read* 0.057.

G.

CORRIGENDA.

Vol. IV. page 2, line —7, 8, column 1, *transpose* preceding *and* following.
" " 3, " 13, " α, *for* 2″.4, *read* 22″.4.

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OBSERVATIONS OF PSYCHE, THEMIS, THE THIRTY-FIRST ASTEROID, AND COMET 1854, IV.

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By JAMES FERGUSON.

[Communicated by Lieutenant S. P. Lee, Acting Superintendent Observatory. — Corrected for refraction.]

PSYCHE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑯ — *		⑯'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1854, Aug. 7	9 51 39.5	5	Argel. Z. 252, 81	+2 18.52	+ 0 8.90	19 56 45.30	—18 34 13.64
		5	" 252, 82	+1 54.63	+ 4 30.22	19 56 45.19	18 34 11.48
8	10 7 21.1	5	" 252, 81	+1 34.19	— 3 12.67	19 56 0.98	18 37 35.21
	10 15 46.0	10	" 252, 82	+1 9.57	+ 1 4.57	19 56 0.13	18 37 37.25
10	9 50 54.1	20	" 252, 82	—0 16.43	— 5 33.86	19 54 44.17	18 44 15.64
14	12 24 51.3	6	" 252, 75	+1 58.53	+ 2 57.82	19 51 47.63	18 57 19.87
17	9 11 2.4	13	" 252, 75	+0 14.29	— 5 41.15	19 50 3.39	19 6 1.96
20	10 43 58.9	10	" 252, 75	—1 26.11	—14 31.29	19 48 22.98	19 14 49.10
22	10 11 46.6	14	" 243, 31	+0 27.87	+20 5.62	19 47 24.17	19 20 30.01
25	8 52 1.1	4	" 243, 31	—0 48.74	+12 29.91	19 46 7.52	19 27 48.82
26	7 33 56.0	12	" 243, 31	—1 10.20	+10 7.33	19 45 46.07	19 30 11.40
29	10 11 25.7	6	" 243, 31	—2 12.24	+ 3 3.04	19 44 43.84	—19 37 15.79

Adopted Mean Places for 1850.0 *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Argel. Z. 252, 81	9	19 54 10.35	—18 35 3.70	Argelander's Zones.
" 252, 82	7	19 54 34.12	18 39 23.00	
" 252, 75	9	19 49 32.62	19 0 58.30	
" 243, 31	7.8	19 46 39.73	—19 40 56.61	

THEMIS.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉔ — *		㉔'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1854, Aug. 14	9 2 43.5	8	Arg. Z. 386, 33	—0 48.56	+3 15.41	16 28 48.67	—22 32 21.33
16	9 2 50.5	2	"	—0 6.02	+1 56.44	16 29 31.17	22 33 40.25
17	8 27 39.1	3	"	+0 16.38	+1 13.45	16 29 53.55	22 34 23.22
20	8 25 0.7	4	"	+1 33.10	—0 57.92	16 31 10.28	—22 36 31.52

Adopted Mean Place for 1850.0 *of Comparison-Star.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Arg. Z. 386, 33	7.8	16 29 21.22	—22 34 27.12	Argelander's Zones.

During these observations *Themis* was of the 13.5 apparent magnitude and seen with much difficulty. The results are proportionately unsatisfactory.

THIRTY-FIRST ASTEROID.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	Planet — Star.		Planet's apparent	
				Δα	Δδ	α	δ
1854.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Sept. 2	10 59 2.5	4	B. A. C. 598	+1 37.02	—11 6.60	1 52 13 .35	—2 57 12.11
	12 1 2.1	5	"	+1 35.68	—11 3.34	1 52 12 .01	2 57 8.86
	13 31 6.6	3	"	+1 34.40	—10 57.50	1 52 10 .73	2 57 3.51
6	15 38 49.5	12	"	—0 10.24	— 7 21.66	1 50 26 .38	2 53 26.89
	16 30 54.4	3	"	—0 11.56	— 7 18.34	1 50 25 .07	2 53 23.56
10	16 19 16.5	7	"	—2 18.28	— 4 8.87	1 48 18 .30	2 50 13.92
12	10 21 26.1	2	Weisse I. 821	+1 24.56	+ 4 18.57	1 47 14 .59	2 48 53.31
		2	B. A. C. 598	—3 21.25	— 2 47.44	1 47 15 .37	2 48 52.26
14	10 6 14.1	8	Weisse I. 808	+0 47.05	— 2 40.84	1 45 58 .69	2 47 27.10
	10 35 45.3	8	" 821	+0 7.11	+ 5 48.68	1 45 57 .49	2 47 23.05
16	10 47 36.1	8	" 808	—0 37.40	— 1 10.20	1 44 34 .37	2 45 56.47
		8	" 821	—1 16.05	+ 7 16.98	1 44 31 .10	2 45 54.68
(¹) 17	10 28 42.7	6	" 773	+0 35.95	+ 1 50.70	1 43(50).73	2 45 8.92
		6	" 808	—1 20.20	— 0 21.03	1 43 51 .60	—2 45 10.16

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 598	7	1 50 22.17	—2 47 34.72	α British Assoc. Catalogue; δ Washington Mural.
Weisse I. 808	9	1 44 57.11	2 46 17.05	Weisse's Catalogue.
" 821	9	1 45 35.58	2 54 42.46	
" 773	9	1 43 0.17	—2 48 30.82	

COMET 1854, IV.

Date	M. T. Washington.	No. of Comp.	Comparison-Star.	☄ — *		☄'s apparent	
				Δα	Δδ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1854, Sept. 21	9 4 48.4	6	B. A. C. 3551	+2 13.13	+ 4 11.97	10 15 46 .16	+66 22 13.43
	9 4 57.2	4	Arg. Z. 176, 67	—3 43.29	+ 0 2.83	10 15(11).47	66 22 11.80
22	8 10 29.1	7	" 104, 58	+3 51.30	+12 12.06	10 24 5 .87	+65 12 10.32

Adopted Mean Places for 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 3551	6	10 13 15.33	+66 19 22.65	Radcliffe Observations.
(²) Argel. Z. 176, 67	6	10 19 10.40	66 23 30.80	Argelander's Zones.
" 104, 58	6	10 19 57.51	+65 1 19.24	

(¹) Perhaps an error of one second in place of star.

(²) There seems some discrepancy in this zone 176 of Dr. ARGELANDER's with the observations of other observers, as well as with those in his zone 106. It is perhaps in the reductions to 1842.

THE INVESTIGATION OF THE CATENARY UPON A CONE OF REVOLUTION WITH A VERTICAL AXIS.

By BENJAMIN PEIRCE, LL.D.,
PERKINS PROFESSOR OF ASTRONOMY AND MATHEMATICS IN HARVARD UNIVERSITY.

[Read before the Harvard Astronomical Society, 1854, September 29.]

1. An investigation of the catenary upon the cone with a vertical axis is given by **Bobillier**, in the twentieth volume of **Gergonne**'s *Annales de Mathématiques*. But his solution is quite formal and unsatisfactory, and contains no allusion to the separation of the curve into portions of which one is finite while the others are infinite, nor does it indicate its peculiar relations to the elliptic functions of **Legendre**.

2. Upon the developed cone, let the vertex be the origin of polar co-ordinates, denote the radius-vector by r, and by ψ the angle which the radius-vector makes with the axis drawn downwards through one of the points below the vertex at which the catenary is horizontal. Let ϱ be the radius of curvature of the catenary upon the developed curve, and s the arc of the catenary, which is supposed to be formed by a homogeneous chain. If ε is the angle which the arc makes with the radius-vector, the equations for ε and ϱ are,

$$\sin\varepsilon = r\, D_s\, \psi\,,$$

$$\cos\varepsilon = D_s\, r\,,$$

$$\frac{1}{\varrho} = D_s\,(\varepsilon + \psi) = D_s\,\varepsilon + \frac{\sin\epsilon}{r} = D_r\,\varepsilon\cos\varepsilon + \frac{\sin\epsilon}{r}\,.$$

If, moreover, T is the tension of the chain, and k the weight of a unit of length of the chain multiplied by the cosine of the angle which the side of the cone makes with the axis, we have

$$D_r\, T = -\,k\,,$$

$$T = k\,(a + b - r)\,,$$

in which b is the radius-vector at the point of intersection with the axis, and a is the length of chord hanging along the side of the cone which would give the tension at this point of intersection. The condition of equilibrium gives, moreover,

$$\frac{1}{\varrho} = \frac{k\sin\epsilon}{T} = \frac{\sin\epsilon}{a+b-r}$$

$$= D_r\sin\varepsilon + \frac{\sin\epsilon}{r}\,.$$

Hence,

$$D_r\log\sin\varepsilon = \frac{1}{a+b-r} - \frac{1}{r}\,,$$

$$\sin\varepsilon = \frac{a\,b}{r\,(a+b-r)}\,.$$

3. It is evident, from the preceding equation, that the curve consists, in its general form, of three portions, one of which is finite and extends from

$$r = a\,,$$

to

$$r = b\,,$$

and the other two portions extend infinitely above and below the two roots a' and b' of the equation

$$r\,(a + b - r) = -\,a\,b\,.$$

The relation of the values of a' and b' to a and b suggests the notation,

$$R = \tfrac{1}{2}\,(a + b) = \tfrac{1}{2}\,(a' + b')\,,$$

$$P^2 = R^2\cos^2\eta = a\,b = -\,a'\,b'\,;$$

in which it is to be observed that b' is always negative, and that η, a, and b are imaginary when P^2 is greater than R^2.

4. To investigate the finite portion, let

$$\sin\eta\,\sin\varphi = 1 - \frac{r}{R}\,,$$

$$\text{tang}\,\beta = \cos\eta\,,$$

$$\sin i = \sin\eta\,\cos\beta\,,$$

$$\sin\theta = \sin i\,\sin\varphi\,.$$

Adopt also the notation of elliptic integrals,

$$\bar{F}_i\,\varphi = \int_\varphi \sec\theta\,,$$

$$\bar{E}_i\,\varphi = \int_\varphi \cos\theta\,,$$

$$\bar{P}_i\,(n\,,\varphi) = \int_\varphi \frac{\sec\theta}{1 + n\sin^2\varphi}\,.$$

Hence,

$$\sin\varepsilon = \frac{P^2}{r\,(2R - r)} = \frac{\cos^2\eta}{1 - \sin^2\eta\,\sin^2\varphi}$$

$$= \frac{\sin^2\beta}{\cos^2\beta - \sin^2\theta} = \frac{\sin^2\beta}{\cos^2\theta - \sin^2\beta}\,,$$

$$\cos\varepsilon = \frac{\cos\theta\,\surd\,(\cos^2\theta - 2\sin^2\beta)}{\cos^2\theta - \sin^2\beta} = \frac{\sin i\,\cos\theta\,\cos\varphi}{\cos^2\theta - \sin^2\beta}\,,$$

$$\text{tang}\,\varepsilon = \frac{\sin^2\beta}{\sin i\,\cos\theta\,\cos\varphi}\,,$$

$$D_\varphi\, r = -\,R\sin\eta\,\cos\varphi\,,$$

$$D_\varphi\, s = \frac{D_\varphi\, r}{\cos\epsilon} = \frac{-\,R\,(\cos^2\theta - \sin^2\beta)}{\cos\beta\,\cos\theta}\,,$$

$$s = R\,(\text{tang}\,\beta\,\sin\beta\,\bar{F}_i\,\varphi - \sec\beta\,\bar{E}_i\,\varphi)\,,$$

$$D_\varphi\,\psi = \frac{\text{tang}\,\epsilon\,D_\varphi\, r}{r} = \frac{\text{tang}\,\beta\,\sin\beta}{(1 - \sec\beta\,\sin\theta)\,\cos\theta}$$

$$= \frac{\text{tang}\,\beta\,\sin\beta}{(1 - \sin\eta\,\sin\varphi)\,\cos\theta} = \frac{\text{tang}\,\beta\,\sin\beta\,\sec\theta}{1 - \sin^2\eta\,\sin^2\varphi}$$

$$+ \frac{\sin i\,\text{tang}^2\beta\,\sin\varphi\,\sec\theta}{1 - \sin^2\eta\,\sin^2\varphi}\,,$$

$$\psi = \text{tang}\,\beta\,\sin\beta\;\bar{P}_i\,(-\sin^2\eta\,,\varphi) + \text{tang}^{(-1)}\frac{\text{tang}\,\theta}{\text{tang}\,\varphi}\,;$$

for it is found by differentiation, that

$$D_\varphi\,\text{tang}^{(-1)}\frac{\text{tang}\,\theta}{\text{tang}\,\varphi} = D_\varphi\,\text{tang}^{(-1)}\frac{\sin i\,\cos\varphi}{\cos\theta}$$

$$= \frac{\sin i\,\sin\varphi\,(\cos^2\theta - \sin^2 i\,\cos^2\varphi)}{(\cos^2\theta + \sin^2 i\,\cos^2\varphi)\,\cos\theta}$$

$$= \frac{\sin i\,\text{tang}^2\beta\,\sin\varphi\,\sec\theta}{1 - \sin^2\eta\,\sin^2\varphi}\,.$$

5. The preceding value of the angle ψ admits of geometrical expression by means of the arc of the spherical ellipse in the form given by Dr. Booth in his memoir in the *London Philosophical Transactions* for the year 1852. His formula (16), applied to the case in which the greater angle of the elliptic cone is a quadrant, becomes, by changing η to i and e to $\sin\eta$,

$$\sigma = \operatorname{tang}\beta\sin\beta\quad \bar{P}_{\imath}\,(-\sin^2\eta\,,\varphi)\,,$$

and therefore

$$\psi = \sigma + \operatorname{tang}^{[-1]}\frac{\operatorname{tang}\theta}{\operatorname{tang}\varphi}\,.$$

For the length of the arc of the finite portion of the catenary, extending from its highest to its lowest point, this equation gives,

$$2\psi_1 = 2\sigma_1\,;$$

and *if the magnitude of this angle is commensurate with the total developed angle of the cone, the chain returns into itself after passing around the cone once, twice, or several times dependent upon the magnitude of the angle of the cone.*

6. To investigate the infinite portions of the catenary, let

$$\sin\varphi' = \frac{A\sec\beta}{A-r}\,,$$
$$\sin\theta' = \sin i\sin\varphi'\,;$$

which give,

$$r = A\,(1-\sec\beta\operatorname{cosec}\varphi')\,,$$

$$D_{\varphi'}s = A\left(\frac{\operatorname{tang}\beta\sin\beta}{\cos\theta'} - \frac{\sec\beta\cos^2\varphi'}{\sin^2\varphi'\cos\theta'}\right),$$

$$= A\,(\operatorname{tang}\beta\sin\beta\sec\theta' + \sec\beta\cos\theta' + \sec\beta\, D_{\varphi'}\,(\cos\theta'\cos\varphi')\,)\,,$$

$$s = A\,(\sec\beta\,\bar{E}_{\imath}\,\varphi + \operatorname{tang}\beta\sin\beta\,\bar{F}_i\,\varphi + \sec\beta\cos\theta'\cos\varphi')\,,$$

$$D_{\varphi'}\psi = \frac{\sin^2\beta\cos\beta\sin^2\varphi'\sec\theta' - \sin^2\beta\sin\varphi'\sec\theta'}{1-\cos^2\beta\sin^2\varphi'}\,,$$

$$= \frac{\operatorname{tang}\beta\sin\beta\sec\theta'}{1-\cos^2\beta\sin^2\varphi'} - \operatorname{tang}\beta\sin\beta\sec\theta' + D_{\varphi'}\operatorname{tang}^{[-1]}\frac{\cos\theta'}{\cos\varphi'}\,,$$

$$\psi = \operatorname{tang}\beta\sin\beta\;\bar{P}_{\imath}\,(-\cos^2\beta\,,\varphi') - \operatorname{tang}\beta\sin\beta\;\bar{F}_i\,\varphi' + \operatorname{tang}^{[-1]}\frac{\cos\theta'}{\cos\varphi'}\,.$$

The term of this value of ψ which involves circular elliptic integrals of the third order, may be expressed by means of a spherical ellipse, of which the parameter is the reciprocal of that previously introduced, because

$$\cos\beta = \frac{\sin i}{\sin\eta}\,.$$

The length of the arc of this ellipse is therefore,

$$\sigma' = \operatorname{tang}\beta\sin\beta\quad \bar{P}_{\imath}\,(-\cos^2\beta\,,\varphi')\,.$$

7. *The finite portion is precisely circular*, when

$$a = b\,.$$

In this case

$$\eta = i = o\,,$$
$$\beta = \tfrac{1}{4}\pi\,,$$

and the equations of the infinite portion become

$$r = A\,(1-\surd 2\operatorname{cosec}\varphi')\,,$$
$$s = A\,\surd 2\,.\cos\varphi'\,,$$
$$\psi = \surd 2\,(\tfrac{1}{2}\pi - \varphi') - 2\operatorname{tang}^{[-1]}\left[(\surd 2 - 1)\operatorname{tang}(\tfrac{1}{4}\pi - \tfrac{1}{2}\varphi')\right].$$

8. When b vanishes, the finite and infinite portions both degenerate into straight lines, which are the sides of the cone.

9. To investigate the infinite portions when P is greater than R, let

$$\operatorname{tang} i' = \sin i\,\surd -1\,,$$
$$\varphi'' = \tfrac{1}{2}\pi - \varphi'\,,$$
$$\sin\theta'' = \sin i'\sin\varphi''\,,$$

whence we find

$$\sin\beta\cos 2' = \surd\tfrac{1}{2}\,,$$

$$r' = R\,(1-\sec\beta\sec\varphi'')$$

$$= P\cot\beta\,(1-\sec\beta\sec\varphi'')\,,$$

$$\cos\theta' = \sec i'\cos\theta''\,,$$

$$D_{\varphi''}s = R\left(\frac{\cos i'\sec\beta\sin^2\varphi''}{\cos^2\varphi''\cos\theta''} - \frac{\operatorname{tang}\beta}{\sqrt{2}\,.\cos\theta''}\right),$$

$$s = R\left(\frac{\sec\beta}{\cos i'}\cos\theta''\operatorname{tang}\varphi'' - \frac{\sec\beta}{\cos i'}\,\bar{E}_{\imath'}\,\varphi'' - \frac{\operatorname{tang}\beta}{\sqrt{2}}\,\bar{F}_{\imath'}\,\varphi''\right);$$

$$D_{\varphi''}\psi = -\frac{\operatorname{tang}\beta\sec\theta''}{1-\cos^2\beta\cos^2\varphi''} + \operatorname{tang}\beta\sec\theta'' - D_{\varphi''}\operatorname{tang}^{[-1]}\frac{\operatorname{tang} i'}{\operatorname{tang}\theta'}$$

$$= -\frac{\cos i'\cos\beta\sec\theta''}{1-\tfrac{1}{2}\sin^2\varphi''} + \cos i'\cos\beta\sec\theta'' - D_{\varphi''}\operatorname{tang}^{[-1]}\left(\cos\beta\cos\varphi''\,\frac{\operatorname{tang}\theta'}{\operatorname{tang} i'}\right) - D_{\varphi''}\operatorname{tang}^{[-1]}\frac{\operatorname{tang} i'}{\operatorname{tang}\theta'}\,,$$

$$\psi = -\cos i'\cos\beta\,\bar{P}_{\imath'}\,(-\tfrac{1}{2}\,,\varphi'') + \cos i'\cos\beta\,\bar{F}_{\imath'}\,\varphi'' - \operatorname{tang}^{[-1]}\cos\beta\cos\varphi''\,\frac{\operatorname{tang}\theta'}{\operatorname{tang} i'} - \operatorname{tang}^{[-1]}\frac{\operatorname{tang} i'}{\operatorname{tang}\theta'}$$

$$= -\cos i'\cos\beta\,\bar{P}_{\imath'}\,(-\tfrac{1}{2}\,,\varphi'') + \cos i'\cos\beta\,\bar{F}_{\imath'}\,\varphi'' - \operatorname{tang}^{[-1]}\frac{\operatorname{tang}^2 i' + \cos\beta\cos\varphi''\operatorname{tang}^2\theta'}{\operatorname{tang} i'\operatorname{tang}\theta'\,(1-\cos\beta\cos\varphi'')}\,;$$

in which the elliptic integral of the third form admits of interpretation by the arc of the spherical ellipse.

10. When $b' = -a'$
these equations may be greatly simplified and reduced as follows.

$$\beta = \tfrac{1}{2}\pi\,, \qquad i' = \tfrac{1}{4}\pi$$
$$\cos\beta = 0\,, \qquad \cos i' = \surd\tfrac{1}{2}$$
$$D_{\varphi''}\psi = \frac{\cos\varphi''}{\surd\,(2 - \sin^2\varphi'')}\,,$$
$$\sin\psi = \frac{\sin\varphi''}{\surd 2}\,,$$
$$\cos^2\varphi'' = 1 - 2\sin^2\psi = \cos 2\psi\,,$$
$$r'^2 = \frac{a'^2}{\cos^2\varphi''} = a'^2 \sec 2\psi'\,;$$

which is the polar equation of the equilateral hyperbola. This case was recognized by Bobillier, and also the obvious fact that two sides of the cone are always asymptotes of the infinite portions of the catenary.

OBSERVATION OF THE ANNULAR ECLIPSE OF MAY 26, IN THE SUBURBS OF OGDENSBURGH, N. Y.

By STEPHEN ALEXANDER, LL.D.,
PROFESSOR OF MECHANICAL PHILOSOPHY AND ASTRONOMY IN THE COLLEGE OF NEW JERSEY.

(*Continued from page 22.*)

Course and Variable Force of the Wind.

The wind a short time before the eclipse began was brisk from the *west-northwest.* During the progress of the eclipse, it changed its course to *north-northwest*, and its intensity had much abated. My impression is, that the wind blew with a somewhat greater force after the end of the eclipse; but this my notes do not expressly state.

Magnetic Intensity.

No magnetic observations were made; but it may be of use, in the interpretation of such observations as have been made elsewhere, to state, that in the evening we had a display of the aurora borealis which was especially conspicuous from 10h. to 10h. 20m.

Daguerreotype Impressions of the Eclipsed Sun and the surrounding Sky.

Our arrangements for these were, of necessity, very hasty, arriving as we did at our place of destination on the evening of the day before the eclipse. It was not until the next day after our place of observation had been selected, and our morning observations for time had been completed and partially reduced, that I availed myself of the opportunity to request Mr. E. H. Olds, daguerrean artist, to procure, if attainable, impressions of the eclipsed sun and the surrounding sky, at the time when the eclipse was expected to be annular. Mr. Olds, though, as I afterwards learned, quite unwell, very kindly acceded to my request, and, having made such arrangements as my brief notice permitted, obtained several impressions at different periods of the eclipse, of which I have preserved four. Having been taken without the intervention of a telescope, they are of course inferior in size and distinctness to those obtained by Mr. Root in New York, under the supervision of Professor Loomis and Mr. Campbell, at Mr. Campbell's Observatory, to which allusion has already been made in the note to p. 17. They exhibit, however, some peculiarities which seem to be worthy of special notice.

The image in three instances out of the four is doubled, or rather there are two images of equal distinctness though not throughout of the same minuteness of outline, and even in the fourth there is a semblance of the second image, though distinctness was prevented by the intervention of a smoked glass.

A careful examination of these pairs of images led to an hypothesis with respect to the formation of a second image in every instance, which was confirmed by subsequent experiment, and which will be stated after a more particular description of the appearances presented by the plates.

In advance of that, it should, moreover, be premised, that the instrument employed is a German one, and is of what is termed a half-size, its aperture about two inches, which, however, was reduced by a diaphragm having a circular opening of about an inch in diameter.

Of the four impressions, No. 1 nearly in the order of time seems to have been taken less than half a minute before the rupture of the annulus: — time of exposure of the plate, *four seconds.* When examined with the microscope (a single lens), the plate shows an image of the annulus traced with no little sharpness and delicacy, though the narrower portion appears double. The interior of the spot representing the moon is white, as a light-colored picture would be if "burnt" by over-action from too long an exposure of the plate, while the edges of the spot are quite dark, as the moon herself appeared. Then, the image of the annulus is white or nearly so; and outside of it is another dark ring somewhat narrower than that which marks the border of the moon within the annulus. Outside of this, again, the plate has a "burnt" look, the color passing from blue into white followed by prismatic tints, with red conspicuous in the outer border.

This outer border extends from about one fifth to somewhat more than one fourth of an inch in diameter, and the whole of the image thus far described occupies an eccentric position on an imperfectly round and white spot not far from an inch in diameter, which is quite abruptly terminated. Near to its outer edge is a narrow dark band, which may be traced with greater or less distinctness all around; but is most conspicuous on the side nearly opposite to the image of the eclipsed sun.

At the side last mentioned, and close to the outer edge of the white spot, occurs the second, and what we may term the *secondary*, image of the annulus, the other being styled the *primary;* these distinctive terms being employed for reasons which will be afterwards apparent.

The *secondary* image has a *vacuity* in place of the white central spot of the moon in the *primary* image; the part of the plate where the vacuity exists appearing, when viewed quite obliquely, as bright and as colorless as other portions of the plate which have been unaffected, or at most but slightly affected, by the chemical action of the light. But outside of this vacuity is, first, quite a narrow white border, then a wider and rather irregular ring of an unequivocally *pea-green* color, followed by another and exterior border of white, with an appendage jutting outward in a direction nearly opposite to that of the narrower part of the ring in the *primary* image, which, as before stated, appears double. All these bands are very sharply defined.

In one position of the plate, in which the obliquity of view is very considerable, the vacuity appears white, and, when viewed through the lens, as if covered with small drops of reduced mercury, and the green portion of the surrounding ring then appears of a very dark tint; while on it may be seen the annulus, faintly traced, but very considerably resembling its appearance in the *primary* image. The size of the primary and secondary images is very nearly the same.

The large white spot, when viewed in some positions, has a ruddy tint, and in others a tint inclining to green. Several fine, nearly parallel and dark bands cross the spot at an angle of something more than 40° with the line joining the centers of the primary and secondary images. An image of the white spot (or that which seems to be such), and nearly of the same size with it, but much fainter, intersects the spot itself, and projects beyond it in the direction of the line of the two images, on the side near that toward which the primary image is situated. As regards right and left, this image of the large spot appears to be the reverse of the spot itself.

The *secondary* image has, moreover, its own white spot surrounding it in part; on which, like the primary image, its position is eccentric and seemingly *toward the same side* of its own spot as regards right and left.

Lastly, we have two other much larger white spots, and of an intermediate intensity, arranged like the others along the line joining the two images and occupying the outer portions of the plate; their exterior outlines very well defined. In form, they seem to be portions of ellipses.

No. 2 was taken $1^{m.}$ and $3^{s.}$ earlier than *No.* 1, when the eclipse was more nearly central: — time of exposure of the plate, *three seconds.*

When examined with the same microscope, several impressions of the annulus are visible; it having been taken several times. As these intersect one another, the form of the moon appears distorted, yet its colors and the other phenomena are, throughout, very much the same with those presented by the other plate, even to the appendage attached to the outer white ring which limits the secondary image; but the parallel bands of the large white spot are *brighter*, not *darker*, than the remaining portions, and the whole plate has been rather more extensively influenced by the light.

The light spot around the *secondary* image can be more extensively traced than in the other instance, and its position as respects right and left seems to be the *reverse* of that around the primary image; which could not be asserted of the otherwise nearly similar appearance in the other plate.

No. 3 was taken about 3½ minutes later than *No.* 1, or about three minutes after the rupture of the annulus: — time of exposure of the plate, *two seconds.* A piece of glass was interposed which was not perfectly clear.

The crescent form of the eclipsed sun can be very plainly traced without the use of the microscope. When magnified, the cusps appear blunted, apparently by the overlapping of images, and in the *secondary* image they are very much blunted. The secondary image is of a *light green* color, with a darker tint along its central line, and it has again its white border, and also a small cloudy spot of a white color attached to it. The central part of the moon's primary image is again white, with the dark border at the edge projected on the sun; but that dark border ends where the disc of the moon reaches the extremity of the sun's cusp. A dark radiation of blue inclining to green extends to a distance equal to about one half of the diameter of the large white spot, and the prismatic tints beyond this cover nearly all the rest of the plate; concealing, as it would seem, some of the fainter phenomena. The position of the crescent in the secondary image, as regards right and left, is the reverse of that in the primary image.

No. 4 was taken about twenty minutes later than *No.* 3: — time of exposure of the plate, *fifteen seconds.* A piece of *smoked glass* was interposed; yet the primary image, when examined with the same microscope, exhibits, though indistinctly, the form of the partially eclipsed sun on a very dark ground. This is surrounded by a *green* border, around which is a broad border of white, and beyond it, again, several prismatic tints, the red conspicuous on the outside.

There is also a secondary image about *three times as near* to the primary as in the three other instances before described. Its color is a *bright green* surrounded by two borders, the inner one yellow and the outer one red. The position of the secondary image, as regards right and left, is, again, the reverse of that of the primary image. White spots are visible on the plate, where the light has passed through openings in the coating of smoke.

A careful examination of the plates soon led to the conclusion that the *secondary* images, and some of the other appearances, might have originated as follows: —

Some of the sun's rays traversed the lens of the camera-obscura as usual, and in passing out were so refracted as afterwards to form the *primary* image. But others of the rays, which had likewise traversed the lens once, were then reflected at its second surface, and, having traversed the lens a second time, were again reflected at the first surface, and, having then passed through the lens a third time, were so refracted that when collected they formed the *secondary* image.

Now as the secondary image is separated from the primary by a distance equal to several diameters of either, it became moreover manifest, that, if the course of the rays were such as is here described, the principal optic axis of the lens could not have been accurately pointed to the sun; and as withal the primary image is eccentrically situated upon the white spot which surrounds it, it also was supposable that the diaphragm might itself have been placed eccentrically.

To test the hypothesis thus indicated, it seemed to be desirable to repeat the process with the sun uneclipsed, and I accordingly requested Mr. Robert M. Boggs, daguerrean artist of New Brunswick, N. J., to do so under my supervision. The trial was made at Princeton with a bright sky, and at a time when the altitude of the sun was nearly the same with that at Ogdensburgh at the time when the eclipse was annular.

Mr. Boggs made his adjustments very carefully. The instrument which he made use of is what is termed "a full-sized," but the aperture of the diaphragm was nearly the same with that which had been used at Ogdensburgh. The diaphragm, by design, was at first placed *eccentrically;* and the plate was exposed for about three *seconds.*

In the full sunlight this plate, which we may designate as *No.* 5, was, to a large extent, badly "burnt"; yet the primary image of the sun is distinctly visible. The middle of this is yellow, inclining to green, around which is a band of light green, while the outer edge is white.

Instead of the white spot visible around the primary image in most of the outer plates, we have here an indistinctly terminated portion of a dark blue color in the region immediately around the image, but fading away into bluish-white at the borders. Within this the primary image is *eccentrically* placed.

In the border of this ill-defined spot are two dark blue spots in place of the *secondary* image. One of these is elliptical, and about as large as the primary image; the other, larger.

A new diaphragm was next introduced, and so arranged that its aperture and the lens were, as near as might be, *concentric.* The plate was then exposed for about *a second.*

Plate No. 6, thus obtained, shows, in place of the primary image of the sun, *a very dark spot*, which seems not, however, to be black, but of a very dark green tint; and, when examined with a microscope, the border of it appears of a green inclining to yellow.

Outside of the dark spot thus bordered is a narrow white border resembling that immediately adjacent to the dark disc of the moon during a total eclipse of the sun. This is surrounded by a broader border of blue, which fades into the white of a large spot with indistinct edges. Near to the edges it shows prismatic tints, in some lights; the red being prevalent toward the outside. This spot is *concentric* with the primary image. In its border are found two spots of nearly the same form and size with those before described which appear in *No.* 5; but the spots in this instance are white instead of green, and they have not the same situation as respects the *direction* of the principal dimensions of the plate, and they are, moreover, *nearer* to the primary image.

The diaphragm was once more adjusted so as to have its opening concentric with the lens, and placed immediately behind it; and the plate exposed for *about three quarters of a second.*

Plate No. 7, thus obtained, bears quite a striking resemblance to a delicate painting in miniature of a total eclipse of the sun.

The well-defined spot which occupies the place of the primary image appears, under the microscope, to be of an excessively dark-green tint, with some appearance of yellow thinly overlaying it in the middle.

The white light of the large spot surrounding this is, as in *No.* 6, most dense close to the edge of the primary image; but the diameter of this white spot is but about one half as great, and the diminution of its light is, at first, less sudden. This white spot is also affected with prismatic tints near its edge when viewed in certain lights, the red being again prevalent toward the outer edge.

Situated on the border of this is a *single* white spot in place of the two spots seen in *Nos.* 5 *and* 6. It approximates in appearance to a *secondary* image in being nearly circular. It is very considerably larger than the primary image, but is still nearer to it than any of the spots are to the analogous representatives of the sun in *Nos.* 5 *and* 6.

The large white spot surrounding the primary image is, in this instance, also *concentric* with that image.

These results seemed in some measure to confirm the preceding conjectures; yet, as the instrument was not the same with that employed in the first instance, I requested Mr. Olds to repeat the experiments with the sun at nearly the same altitude as at the time of the annular eclipse, and with wind and weather also as nearly as might be the same. Having waited some time for a day uniting these advantages, he on the 19th of July made several careful trials with the very instrument and diaphragm which were employed on the day of the eclipse; and sent me a highly beautiful impression of the uneclipsed sun and surrounding region of the sky: — time of exposure being *one second.*

This, which we may style *Plate No.* 8, presents in some respects even a more perfect picture of a total eclipse of the sun than that exhibited by *No.* 7, though the white light around the dark central spot or primary image, as seen under the microscope, is not quite so sharply defined at its inner edge.

The primary image has, however, almost the same precise characteristics as that seen in *No.* 7. The white light surrounding the primary image is relatively less extensive than that in *No.* 7, though the prismatic tints of its border may perhaps be more readily traced. This light is, however, surrounded by a fainter glow, and around *it* again is a large still fainter and nearly circular spot, of the size of those obtained at the time of the annular eclipse, but unlike them in being very nearly concentric with the primary image.

(*To be continued.*)

EPHEMERIS OF THE THIRTY-FIRST ASTEROID.

The accompanying ephemeris has been computed by Mr. Ferguson from the elements of Professor Keith, published in the last number of this Journal.

THIRTY-FIRST ASTEROID.

Berlin Mean Midnight.

Date.	α h. m. s.	δ ° ′ ″	Log *r*	Log △
Sept. 5	1 51 2	—2 54 57	0.43634	0.28104
9	49 0	51 49	.43649	.27359
13	46 32	48 58	.43664	.26674
17	1 43 42	—2 46 13	0.43681	0.26065
Sept. 21	1 40 30	—2 43 18	0.43699	0.25537
24	36 58	40 2	.43708	.25083
29	33 8	36 3	.43729	.24750
Oct. 3	29 3	31 12	.43748	.24515
7	24 48	25 13	.43768	.24392
11	20 36	17 56	.43787	.24380
15	16 17	2 9 25	.43806	.24445
19	12 0	1 59 21	.43828	.24622
23	7 49	47 29	.43850	.24937
27	3 49	33 49	.43873	.25345
31	1 0 3	—1 18 18	0.43897	0.25861

FOURTH COMET OF 1854.

A Comet was discovered on the 13th instant by Mr. Robert Van Arsdale at Newark, N. J. The sky becoming suddenly overclouded, the comet's motion could not be satisfactorily determined until the 15th, when another observation was obtained. The approximate places as given by Mr. Van Arsdale are,

	Newark M. T. h. m. s.	α h. m. s.	δ ° ′
Sept. 13	9 50 30	8 21 36	+74 30
15	9 38 0	8 56 54	+72 51

B. A. GOULD, Jr.

Cambridge, 1854, *September* 18.

P. S. I succeeded with difficulty in finding the comet on the 18th between thickly flying clouds, and obtaining an estimate of its position by means of the circle-readings of the Shelby Equatorial. Its position on the first clear night was,

	Cloverden M. T. h. m. s.	☄ α ° ′ ″	☄ δ ° ′ ″
Sept. 20	10 7 21.1	151 33 58.5	+67 38 7.9
	16 0 49.1	152 14 8.3	+67 13 56.2

G.

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Observations of Psyche, Themis, the Thirty-First Asteroid, and Comet 1854, IV., made with the Filar-Micrometer of the Washington Equatorial, by James Ferguson, Esq.
The Investigation of the Catenary upon a Cone of Revolution with a Vertical Axis, by Professor Benjamin Peirce.
Observation of the Annular Eclipse of May 26, in the Suburbs of Ogdensburgh, N. Y., by Professor Stephen Alexander.
Ephemeris of the Thirty-First Asteroid.
Fourth Comet of 1854.

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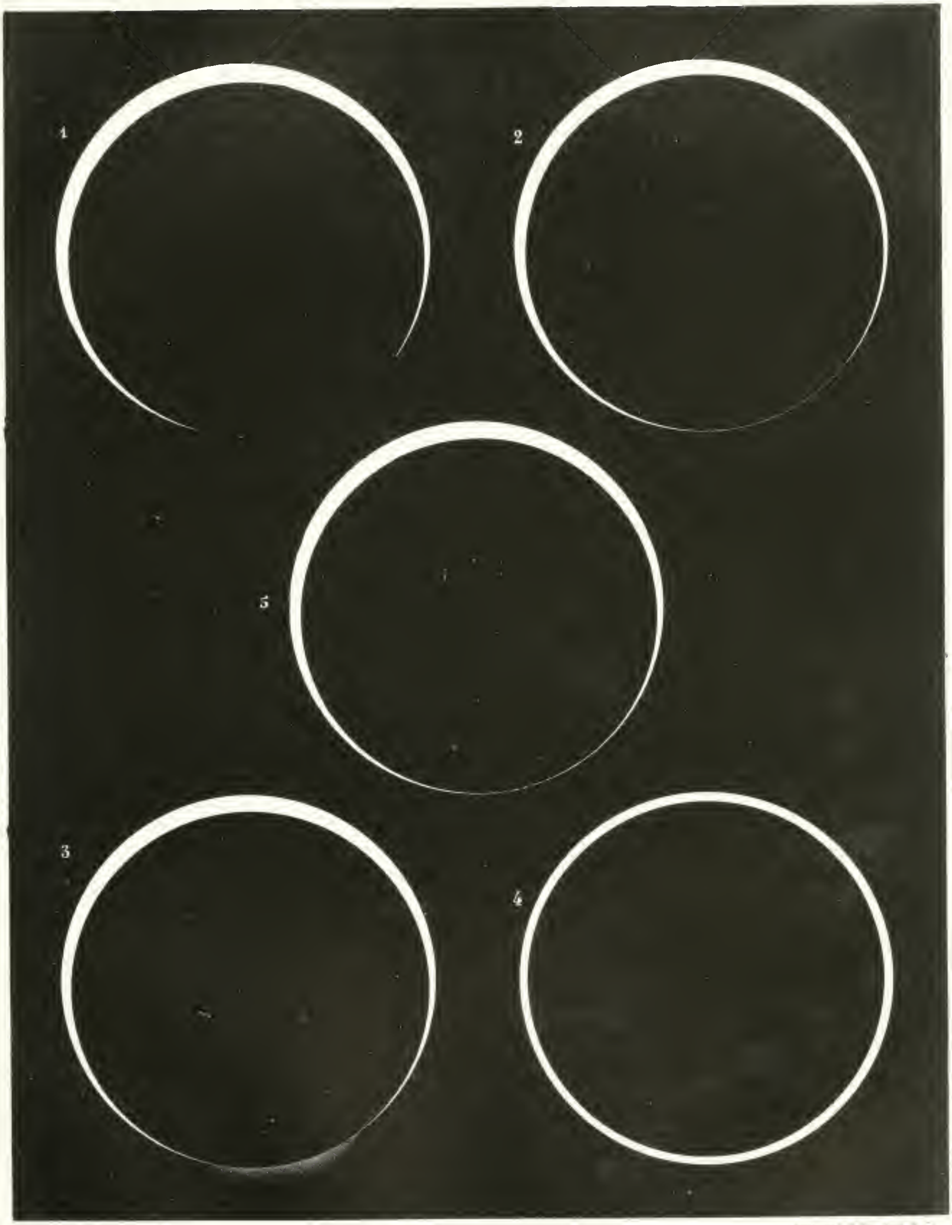

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No. 77.

VOL. IV. CAMBRIDGE, 1854, NOVEMBER 10. NO. 5.

ON THE SOLAR ECLIPSE OF 1854, MAY 26.

By W. H. C. BARTLETT, LL.D.,

PROFESSOR IN THE U. S. MILITARY ACADEMY.

The usual efforts to observe the precise times of the contacts of a solar eclipse are attended with uncertainty, and frequently with disappointment. The state of the air, the presence of a cloud, accidents to the instrument, and the like, at the moment, often defeat the most careful preparation.

And even when obtained free from doubt, these times are but insulated elements, and tainted with the errors incident to all instrumental observations.

Repeated measurements of the angular distance between the points of the solar *cusps*, during the progress of the eclipse, promise to remove these objections. They give data sufficient to correct both the tables and terrestrial longitude, and afford by their number the means of applying the principle of general average to the elimination of errors of observation.

In the earlier and later stages of the eclipse, this distance varies rapidly, and the times corresponding to measured values may be noted with great accuracy. The distance between the solar cusps, carefully measured, the augmented semidiameter of the moon, computed by the ordinary process, and the solar radius given in the tables, are data from which, by an easy process too obvious to need explanation, the corresponding apparent distances between the centers of the sun and moon will result.

This distance being substituted for the sum or difference of the solar and lunar radii in the usual process for correcting tables and longitude, will give as many equations as measurements. The errors of longitude and of the tables being made to enter these equations as unknown quantities, and the equations treated by the method of least squares, such values for the corrections may be found as shall best satisfy the observations.

My first efforts at these measurements were made in 1844, and with a position-micrometer on a telescope mounted equatorially and moved by clock-work; they were not very successful, the instrument requiring the use of *three* hands, — two to adjust the movable wires, and a third the position-circle. The last efforts, of which the results are herewith communicated, were, it is hoped, more fortunate. In these measurements the movable wires were abandoned, and the eye-piece of the micrometer replaced by a dynameter. The divided eye-glass of the latter instrument duplicated the solar image, and by a combined motion of the position-circle and dynameter-head, requiring but two hands, the points of the cusps were easily brought together, and the time noted.

Through the kindness and professional skill of Mr. Victor Prevost, of New York, who was induced to come to West Point for the purpose, I was enabled also to obtain nineteen photographs of as many different phases. The corresponding times of these phases were carefully noted. The photographs were made by means of a small camera adapted to the eye-end of a refracting telescope of which the aperture was six inches and the solar focal length eight feet. The impressions were taken within the interval required to remove an opaque cap from the object-glass and replace it again without loss of time, so that the effect may, for all practical purposes, be said to have been instantaneous.

These photographs being illuminated and viewed through a telescope provided with a micrometer, the chords of the cusps may be determined in terms of the solar diameter represented by that of its photographic image; or the same may be done by a scale of equal parts. The photographs, being taken at different intervals in the course of the measurements, became good checks on the latter, and may also be used as a series by themselves.

By careful measurement of the solar disc, it was found that 675 dynameter units = 1896.2 seconds in arc.

The barometer and thermometer were noted during the progress of the eclipse, and the results are also annexed. With unimportant exceptions the weather was very fine during the entire eclipse.

West Point, N. Y. $\begin{cases} \text{Longitude, } 4^{h.}\ 55^{m.}\ 50^{s.}.10, \\ \text{Latitude, } 41^\circ\ 23'\ 31''.23. \end{cases}$

SOLAR ECLIPSE, 1854, MAY 26.

Number.	Mean Solar Time.	Chord in Dy. Units.	Chord in Arc.	Remarks.
	h. m. s.		″	
1	4 14 47.3	0.0	0.0	*First contact;* wind north, brisk breeze, clear, blue sky.
2	4 21 1.0	260.75	732.49	
3	4 22 30.0	280.50	787.98	
4	4 25 57.4	341.25	958.63	
5	4 28 4.0			Photograph No. 1.
6	4 28 55.4	376.25	1056.96	
7	4 30 43.7	398.25	1118.76	
8	4 34 17.8			Photograph No. 2.
9	4 34 44.7	431.25	1211.46	
10	4 36 42.2	449.75	1263.43	
11	4 39 59.6	479.50	1347.01	
12	4 41 31.8			Photograph No. 3.
13	4 43 12.7	496.33	1394.28	
14	4 45 49.5	522.25	1467.09	
15	4 47 57.3			Photograph No. 4.
16	4 48 36.0	533.80	1499.54	
17	4 52 57.4	563.00	1581.57	
18	4 54 26.7			Photograph No. 5.
19	4 56 29.3	573.00	1609.66	
20	4 58 54.9	590.66	1659.27	
21	4 59 49.3			Photograph No. 6.
22	5 2 30.5	594.50	1670.06	
23	5 4 13.5	605.00	1699.56	
24	5 7 35.0	617.00	1733.27	
25	5 10 4.2			Photograph No. 7.
26	5 11 16.2	619.75	1740.99	
27	5 13 7.1	628.25	1764.87	
28	5 16 44.2			Photograph No. 8.
29	5 18 19.9	634.20	1781.58	Clouds forming just north of sun.
30	5 22 2.0	637.50	1790.86	
31	5 22 57.1			Photograph No. 9. Slight clouds over sun.
32	5 24 42.4	623.25	1750.82	Slight clouds north of sun.
33	5 26 55.8	610.50	1715.01	Clouds just below sun.
34	5 28 31.3	607.40	1706.29	Very good.
35	5 30 3.7	602.00	1691.13	Very good.
36	5 30 32.0			Photograph No. 10.
37	5 32 27.0	600.75	1687.62	Clouds about sun.
38	5 36 27.1			Photograph No. 11.
39	5 37 46.6	626.25	1759.25	
40	5 39 32.5	632.25	1776.11	
41	5 42 19.3			Photograph No. 12.
42	5 42 51.3	630.75	1771.89	
43	5 45 37.4	627.75	1763.47	Very good, wind abating.
44	5 48 25.0			Photograph No. 13.
45	5 49 2.9	620.25	1742.39	Hazy in west, wind north.
46	5 51 55.1	616.50	1731.86	
47	5 53 58.5			Photograph No. 14.
48	5 54 38.4	600.25	1686.21	
49	5 56 8.7	592.50	1664.44	
50	5 58 15.9			Photograph No. 15.
51	6 0 35.9	585.00	1643.37	
52	6 2 38.2			Photograph No. 16.
53	6 3 1.9	574.75	1614.58	
54	6 4 45.9	563.00	1581.57	
55	6 6 14.3			Photograph No. 17.
56	6 6 41.2	552.00	1550.67	
57	6 8 28.1	541.75	1521.88	
58	6 10 15.2			Photograph No. 18.
59	6 11 3.9	526.25	1478.33	
60	6 12 50.3	510.00	1432.68	

Number.	Mean Solar Time.	Chord in Dy. Units.	Chord in Arc.	Remarks.
	h. m. s.		″	
61	6 14 33.0	499.50	1403.19	
62	6 15 2.4			Photograph No. 19.
63	6 15 58.0	487.50	1369.48	
64	6 17 7.9	475.75	1336.47	Slightly cloudy.
65	6 18 22.9	465.50	1307.68	
66	6 19 28.3	455.25	1278.88	
67	6 20 36.4	442.50	1243.06	
68	6 21 33.8	429.50	1206.54	
69	6 22 36.0	418.00	1174.24	Clouds north of sun.
70	6 23 51.5	401.50	1127.89	
71	6 25 38.3	380.66	1069.31	
72	6 29 21.2	315.66	886.74	
73	6 37 13.7	0.0	0.0	*Last contact;* some mirage, wind fresh and increasing.

Barometer and Thermometer.

Number.	Barometer.	Thermometer Fahrenheit.	Time.
	Inches.	°	h. m.
1	29.741	72.9	4 30
2	29.75	72.75	4 45
3	29.742	72.0	5 0
4	29.74	70.5	5 15
5	29.72	70.45	5 30
6	29.75	70.3	5 45
7	29.76	70.0	6 0
8	29.76	69.50	6 15

OBSERVATION OF THE ANNULAR ECLIPSE OF MAY 26, IN THE SUBURBS OF OGDENSBURGH, N. Y.

By STEPHEN ALEXANDER, LL.D.,
PROFESSOR OF MECHANICAL PHILOSOPHY AND ASTRONOMY IN THE COLLEGE OF NEW JERSEY.

(*Continued from page* 32.)

The *secondary* image is as distinct in its tints and as sharply defined as it would be if it were formed by a small drop of paint applied to the plate and suffered to dry. It is *nearly in contact* with the primary image, and in color and general appearance this *secondary* image not a little resembles the *primary* image of *No.* 5, which is the result of a longer exposure; it being green in the middle, surrounded by yellow, passing into white at the edges. The green, however, is by no means as dark and uninterrupted as that of the *secondary* rings which appear in the impressions of the annular eclipse.

Mr. Olds found that, by changing "the position of the camera," he could "throw the second image near to the primary, or in any corner of the plate," and that, "using another diaphragm and with colored glass turned a little from the other," he could "produce four impressions at the same time"; and also, that he could "so adjust the camera as to get one only."

The results of these various experiments seem to be quite sufficiently conclusive as to the origin of the secondary images.

It will also be observed, that the various results, both under the peculiar circumstances of the eclipse and otherwise, unitedly indicate that the *photographic effect of the border light of the sun* (such as was alone exposed at the time of the annular eclipse) is *different in some respects from that of the central portions of the disc.*

The dark edge of the image of the moon, and the brighter tint in the middle, would also seem to indicate *a difference of photographic effect in the border light or emanation from the edges of her disc in comparison with the central part of the same*, when *the dark side at the time of a solar eclipse is turned toward us.*

Also, it would seem that the *bright glare of the sun's direct rays interferes with the rapid delineation* of them by process of M. Daguerre; inasmuch as the shortest available intervals seem to be sufficient when the light is enfeebled by reflection, as in the case of the *secondary images;* while a longer interval is required for the brighter light of the primary images.

Lastly, the distinct delineation of the region immediately around the sun, and the manifest resemblance of that delineation to what we see during a total eclipse of that luminary, might seem to render it supposable that (with the intervention of the telescope) some of the peculiar phenomena presented by the substance or substances immediately surrounding the sun might have their pictures photographically traced: including possibly some which, like the luminous projections beyond the moon's disc, have, it may be, been seen only during certain total eclipses; especially if we contrive somewhat to soften the light of the sun by means of glasses of a neutral tint, or otherwise, or else artificially eclipse or conceal the sun's disc while the neighboring region remains exposed.

The lithographic diagrams illustrating this paper have been furnished by the Smithsonian Institution.

OBSERVATIONS OF EUPHROSYNE AND OF THE FOURTH COMET OF 1854,

MADE AT CLOVERDEN

WITH THE FILAR-MICROMETER OF THE SHELBY EQUATORIAL.

By B. A. GOULD, Jr. and JOSEPH WINLOCK.

EUPHROSYNE.

1854.	Cloverden M. T.	Comparison-Star.	$\Delta\alpha$	No. of Comp.	$\Delta\delta$	No. of Comp.	㉛ α	㉛ δ	Observer.
	h. m. s.		m. s.		′ ″		° ′ ″	° ′ ″	
Sept. 12	13 34 28.1	Weisse I. 808	+2 0.0	5	−4 1.3	4	26 47 53.9	−2 48 43.2	G.
	13 31 28.1	" 894	−3 25.4	5	−2 39.0	4	26 47 48.5	2 48 46.7	G.
17	11 56 12.5	" 808	−1 22.6	2	−0 23.4	2	25 57 16.1	2 45 5.5	W.
	12 49 18.3	" 773	+0 32.6	8	+1 53.1	8	25 57 9.3	2 45 5.7	W.
20	12 4 41.3	" 773	−1 45.4	8	+4 13.6	7	25 22 39.9	2 42 44.9	G.
	12 34 5.9	" 808	−3 42.8	4	+1 56.7	4	25 22 14.0	2 42 44.9	G.
21	12 23 37.2	" 773	−2 36.5	3	+5 0.1	3	25 9 53.5	2 41 58.2	W.
22	12 21 23.1	" 773	−3 25.1	6	+5 33.7	5	24 57 44.9	2 41 24.5	G.
(1)	12 37 3.2	Lalande 3237	+1 22.5	2	−1 50.4	3	24 57 28.9	2 41 4.6	G.
23	14 31 3.4	"	+0 26.3	9	−0 54.1	6	24 43 25.9	2 40 8.4	W.
24	12 27 13.0	"	−0 21.8	15	−0 4.1	2	24 31 23.7	−2 39 18.4	G.

Mean Places for 1854.0 *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse I. 894	7	1 50 34.33	−2 46 26.5	Twelve-Year Catalogue, 176.
" 808	9	1 45 9.28	2 45 0.7	δ Washington Obs.; Prof. Yarnall.
" 773	9	1 43 13.59	2 47 17.4	" "
Lalande 3237	9	1 38 21.89	−2 39 33.4	" "

COMET 1854, IV.

1854.	Cloverden M. T.	Comparison-Star.	$\Delta\alpha$	No. of Comp.	$\Delta\delta$	No. of Comp.	☄ α	☄ δ	Observer.
	h. m. s.		m. s.		′ ″		° ′ ″	° ′ ″	
Sept. 20	10 15 1.7	*a*	+0 50.11	6	+ 0 55.0	3			G.
	10 7 20.5	*b*			− 3 24.0	3			G.
	16 0 49.1	Argel. Z. 176, 49	+5 30.96	5	+ 6 7.3	5	152 14 8.2	+67 13 56.2	G.
21	10 39 7.7	" 176, 60	+2 37.90	5	+ 0 52.0	4	154 2 39.4	66 18 52.4	W.
	10 59 30.2	" 176, 67	−3 11.48	4	− 4 38.0	4	154 4 20.1	66 17 20.1	W.
22	8 32 28.6	" 104, 66	−0 46.73	6	+ 5 27.2	5	156 1 50.7	65 12 43.1	G.
	8 31 2.3	" 104, 65	−2 36.20	6	+ 6 57.6	5	156 1 41.8	65 12 38.7	G.
23	8 11 8.7	" 104, 71	+0 46.28	7	+ 5 20.1	7	157 57 23.5	64 0 32.8	W.
	9 9 27.3	" 104, 75	−0 30.91	7	+ 9 33.9	3	158 2 15.7	63 57 28.3	W.
	15 31 0.1	" 101, 75	+1 29.54	6	−10 5.9	6	158 32 22.5	63 37 48.5	W.
21	8 45 20.4	*m*	−0 30.70	7	− 8 42.4	4			G.
	9 6 13.4	*n*	−2 10.53	6	− 0 51.1	5			G.
25	12 44 47.9	Argel. Z. 102, 118	+0 15.41	6	+ 2 5.8	12	161 41 59.8	61 16 42.6	W.
26	7 52 3.2	*k*	−0 28.20	5	− 2 24.9	4			G.
	7 52 3.2	Argel. Z. 102, 127	−1 33.65	5	− 2 5.9	4	162 52 36.1	+60 16 39.4	G.

(1) Probably an error of one rev. = 20″.87 in declination.

Mean Places for 1854.0 *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
a		10 6	+67 30	
b			67 35	
Argel. Z. 176, 49	9	10 3 25.61	67 7 58.3	Argelander's Zones.
" 176, 60	5	10 13 32.70	66 18 10.4	
" 176, 67	6	10 19 28.79	66 22 16.1	
" 101, 66	9.0	10 21 51.13	65 7 25.4	
" 104, 65	9	10 26 43.01	65 5 50.5	
" 104, 71	9	10 31 3.32	63 55 22.0	
" 104, 75	8.9	10 32 39.99	63 48 3.7	
m		10 40	62 53	
n		10 42	62 44	
Argel. Z. 102, 118	9	10 46 32.58	61 14 45.6	Argelander's Zones.
k	9.0	10 52	60 19	
Argel. Z. 102, 127	9	10 53 4.06	+60 18 53.5	Argelander's Zones.

OBSERVATIONS OF COMET 1854, IV., AND EUPHROSYNE.

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By JAMES FERGUSON.

[Communicated by Lieutenant MAURY. — Corrected for refraction.]

COMET 1854, IV.

	Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	☄ — * Δα	☄ — * Δδ	☄'s apparent α	☄'s apparent δ
	1854.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
(1)	Sept. 21	9 4 48.4	6	B. A. C. 3531	+2 13.12	+ 4 11.88	10 15 46.04	+66 22 12.55
		9 4 57.2	4	Arg. Z. 176, 67	—3 43.29	+ 0 2.83	10 15 45.42	66 22 7.64
	22	8 10 29.1	7	" 104, 58	+3 51.29	+12 13.05	10 24 5.60	65 12 20.06
	23	8 6 37.4	9	" 104, 75	—0 42.24	+11 31.32	10 31 57.41	63 59 25.91
	24	7 55 28.1	5	" 104, 86	—4 14.08	— 9 4.19	10 39 5.44	62 45 45.31
	26	7 58 53.7	6	" 102, 121	+2 20.74	+11 21.72	10 51 38.48	+60 15 0.07

Adopted Mean Places for 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 3531	(5.6)	10 13 15.21	+66 19 21.75	Radcliffe Observations, and B. A. C.
Argel. Z. 176, 67	6	10 19 11.31	66 23 28.61	Argelander's Zones.
" 104, 58	6	10 19 57.24	65 1 28.98	
" 104, 75	(8.9)	10 32 23.32	63 49 18.05	
" 104, 86	8.9	10 43 3.86	62 56 14.40	
" 102, 121	8	10 49 2.75	+60 5 3.99	

EUPHROSYNE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉛ — * Δα	㉛ — * Δδ	㉛'s apparent α	㉛'s apparent δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Oct. 5	9 10 12.6	10	Weisse I. 450	+1 14.62	+10 22.55	1 27 28.60	—2 26 17.65
7	9 16 55.9	5	" 432	+0 1.79	+ 0 55.84	1 25 21.15	2 23 2.56
	*	*	*	*	*	*	*
17	9 50 49.3	12	Weisse I. 206	+0 56.06	+ 2 53.24	1 14 25.04	2 1 31.17
19	9 26 41.9	12	" 206	—1 13.86	+ 8 17.49	1 12 15.11	—1 56 7.22

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(1) The first two observations are published in the *Astronomical Journal*, No. 76. Some errors in the reductions made then are corrected here.

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse I. 450	8.9	1 25 59.07	−2 38 14.42	α Weisse's Catalogue ; δ Wash. Mural ; Prof. Yarnall.
" 432	9	1 25 4.43	2 25 32.14	Weisse's Catalogue.
" 206	8	1 13 13.93	−2 5 59.15	

ON THE FOURTH COMET OF 1854.

BY B. A. GOULD, JR.

THE geocentric path of this comet was peculiarly unfavorable for the determination of an orbit by the ordinary process in which the eccentricity is left indeterminate. An erroneous comparison-star in the Cloverden observation of September 20, and subsequently an error in the place as given by the Berlin observation of September 12, led to great discordances, but the following parabola from the first Berlin, and the first and the last Cloverden observation, is believed to satisfy the entire series within reasonable limits.

T	1854, Oct. 27.35980	Greenwich M. T.
π	94° 12′ 49″.1	
☊	324 35 33.9	
i	40 59 28.8	
Log q	9.903504	

the longitudes being referred to the mean equinox of 1854.0.

These elements give the following ephemeris, also referred to the mean equinox of January 0.0, and computed for Greenwich mean noon.

1854.	☄ α	☄ δ	Log r	Log △
Sept. 9	98° 13′ 13″.4	+75° 59′ 31″.4	0.078489	9.929571
10	101 35 5.1	75 54 40.5	.073838	.928109
11	110 48 59.3	75 40 6.6	.069163	.926870
12	116 47 20.7	75 16 16.3	.064467	.925854
13	122 24 16.3	74 43 52.9	.059752	.925060
14	127 36 7.6	74 3 49.7	.055019	.924485
15	132 21 20.3	73 17 4.7	.050270	.924125
16	136 40 0.0	72 24 35.4	.045507	.923979
17	140 33 19.3	71 27 15.8	.040734	.924041
18	144 3 11.8	70 25 53.8	.035953	.924307
19	147 11 47.9	69 21 12.4	.031167	.924771
20	150 1 22.4	+68 13 47.8	0.026379	9.925427
Sept. 21	152° 34′ 4″.4	+67° 4′ 11″.4	0.021592	9.926270
22	154 51 53.6	65 52 49.6	.016811	.927296
23	156 56 37.0	64 40 4.0	.012039	.928492
24	158 49 50.1	63 26 12.6	.007280	.929851
25	160 32 56.1	62 11 32.8	0.002540	.931371
26	162 7 7.7	60 56 17.1	9.997824	.933043
27	163 33 28.2	59 40 36.4	.993136	.934860
28	164 52 52.4	58 24 40.1	.988482	.936812
29	166 6 8.4	+57 8 35.5	9.983868	9.938893

A strong resemblance to the first comet of 1845, discovered by D'ARREST, 1844 December 28, suggested itself upon the comparison of the first computed parabola with the cometary records, and this resemblance seemed in no respect diminished by a more accurate determination of the elements of the present comet, obtained by the use of a longer interval between the extreme observations. Indeed, an ephemeris computed with the elements of the Comet 1845, I., with the single substitution of 1854 October 27.5, as the time of perihelion passage, gave an ephemeris varying on no day so much as 4° in $\alpha \cos \delta$, or $1\frac{1}{4}$° in declination, from the observed path of the present comet.

A decided, though less close resemblance, to the second comet of 1793 was also manifest. For this BURCKHARDT suspected a period of ten years, making it identical with the comet of 1783, and at any rate obtained strong indications of decided ellipticity in the orbit. The degree of similarity may be more readily observed by a comparison of the three sets of elements in juxtaposition. The longitudes are in each case referred to the mean equinox of the beginning of the year of perihelion passage.

	1854, IV.	1845, I.	1793, II.
T	1854, Oct. 27.3598	1845, Jan. 8.19309	1793, Nov. 28.60631
☊	324° 35′ 33″.9	336° 44′ 30″.3	359° 4′ 48″
π	94 12 49.1	91 19 39.1	75 58 58
i	40 59 28.8	46 50 30.1	47 35 5
Log q	9.9035038	9.9567392	0.14161360
e			0.7347635

In connection with this similarity the interesting circumstance soon became manifest, that the passages of the ascending and descending nodes upon the ecliptic of the Comet 1854, IV. occur at the points where the radius-vectors are 5.05 and 0.9 respectively, that is to say, in close proximity to the orbit of *Jupiter* in the former, and of the *Earth* in the latter case.

The present comet passed its descending node during the first week of January, 1854, at which time, however, *Jupiter* was distant about 37° of heliocentric longitude, too far removed apparently to exert any very marked influence in deranging the position of the orbit plane.

Continuing the comparison, the heliocentric longitudes of the three comets under consideration were examined for that point in their orbits where the radius-vector was equal to the mean distance of *Jupiter*, — with the following results.

☄	l	$☊ - l$
1793, II.	310° 59′ 9″	48° 56′
1845, I.	325 42 1	11 10
1854, IV.	322 45 23	1 13

These curious points of similarity seemed to render it imperative to proceed in the inquiry. The parabolic elements given by Faye, d'Arrest, Hind, Nicolai, and Goetze, for the fourth comet of 1845, agree with peculiar precision, — so closely, indeed, that Nicolai called attention to the circumstance, as also has Galle in his *Kometen-Verzeichniss*. The residuals as given by Goetze (*A. N.* XXIII. 169) for six normal places, and by Nicolai (*Ibid.* pp. 171, 172) for four, amount in no case to more than $7''.7$ in $\Delta\alpha \cos\delta$, or $8''.5$ in δ, although there appears to be a progression in sign and amount which might reasonably suggest the suspicion of a slight degree of ellipticity. In alluding to the similarity of his parabola to those previously published, Nicolai mentions (*A. N.* XXIII. 171) that a "considerable change in the observations would occasion but an insignificant modification of the elements." Does not this same circumstance indicate that a considerable variation from the parabolic form might fail to render itself manifest?

The geocentric path of the fourth comet of 1854 was, as has been stated, unfavorably situated for the determination of the form of the orbit, inasmuch as the great circles connecting the places of the earth and comet differed but slightly in their inclinations to the ecliptic. I therefore endeavored to test the question by drawing an ellipse of ten years through the normal places given by Goetze as the basis of his parabolic elements. These normal places, referred to the mean equinox of 1845.0, are

M. T. Berlin.	☄ λ	☄ β
1845, Jan. 10.0	301° 6′ 47″.01	+62° 26′ 34″.86
Feb. 7.0	204 10 19.81	+79 12 55.40
March 7.0	141 52 39.50	—11 54 54.26

The radius-vector and chord corresponding to the extreme places being deduced for a ten-year period by successive approximations and substitutions in the formula for elliptic motion, the computation has furnished the following Elements, — referred to the mean equinox of 1845.0, and Berlin mean time.

T	1845, Jan. 4.1926
☊	337° 5′ 27″
π	87 44 35
i	42 24 30
φ	54 0 46
Log q	9.947309

In this ellipse it will be observed that the inclination is diminished to an angle nearly identical with that furnished by the parabolic elements of the comet of this autumn, and that the change of perihelion distance also tends to diminish the difference between the two. But the discordance of the middle place when compared with the ellipse is unfavorable to the hypothesis of identity. The comparison gives,

Calc. — Obs.

$\Delta\lambda \quad -1^\circ\, 29'\, 41''.8 \qquad \Delta\beta \quad -0'\, 4''.4$

It must, however, be borne in mind, that this discrepancy in the geocentric longitude amounts in fact to only 16′ 47″.8 of a great circle, and that the corresponding period of ten years (or more strictly $9^{y}.998$) was perfectly arbitrary. The question is richly deserving of farther discussion, and nothing but the want of the requisite time prevents a continuance of the investigation at present. Although the results already attained may appear negative in their character, they may be deemed even as such worthy of record.

OBSERVATIONS OF THE ECLIPSE OF MAY 26, AT VARIOUS PLACES.

Communicated by Professor Alexander.

Captain Thomas Lavender observed at his own residence, within the borough of Princeton, about two miles northeast of Nassau Hall.

Captain Lavender had smoked the object-glass of his telescope. Through the instrument thus prepared he observed an *agitation of the sun's limb* at the place at which the eclipse was about to begin, and also *a narrow dark line within the edge of the disc, its convexity outward.* He glanced at the timekeeper for the purpose of noting the hour, and as soon as possible recovered the view of the sun in the telescope, and then the eclipse had begun. Captain Lavender has been much accustomed to the use of the telescope, in the course of a long nautical experience.

The Newark (N. J.) *Daily Advertiser* of May 27 mentions that "a serrated appearance on the moon's edge on the southern cusp was noticed through the telescope at the commencement of the eclipse."

It also states, that "some observers distinctly traced the line of the moon's circumference for some distance" on each side outwardly, beyond the points of intersection of the sun and moon, as the eclipse was going off.

Mr. Samuel Haskell, Preceptor of Clinton Academy, Easthampton, Long Island, and then a member of the Senior Class of the College of New Jersey, observed the eclipse of May 26, at Dover, N. H., very near to the time of the central eclipse. His telescope was a three-foot achromatic refractor, aperture $2\frac{1}{8}$ inches, screen-glass *red*.

The intervention of large masses of flying clouds completely interrupted the observations for time, and the other observations were made when views were obtained, at intervals, through the openings which occurred when the clouds were partially broken.

In this way the first contact was noticed, but no appearance of the moon before contact, although sought for.

Several physical phenomena were observed, which Mr. Haskell, in a letter to myself, describes as follows: —

"(*a*.) *A violent agitation* on the moon's disc. At about $2\frac{1}{2}$ digits' obscuration this became conspicuous, and seemed to be more and more so till the time of four digits' obscuration. I think the most careless observer would have noted it. The great characteristic of this seemed to be a sort of turbulence, such as would naturally proceed from sudden rarefaction and condensation.

"(*b*.) '*An intensity of light*' *bordering the moon's disc.*

"This also was eminently conspicuous. Around the black disc of the moon, this band formed a beautiful crown. Red rays abounded in a part of it, near the center of the bright band."

Distortion of the cusps was suspected, but the phenomenon was not unequivocal. The heavy clouds afforded Mr. Haskell but mere glimpses after this, until the moment of the central eclipse, when a view of the perfect ring was obtained on the background of a perfectly clear spot in the sky, and surrounded by the clouds as a grand natural framework.

As the rupture of the annulus approached, he seems to have observed something like Baily's dark lines. In his description of the phenomenon he says: —

"I discovered the serrated appearance, but not so distinctly as I wished or expected. I saw it; of that I feel certain. The best view of it" was obtained "when the moon in her passage had gone half the width of the ring in passing from a central position. The beaded spots wore a silvery aspect, — like bright molten silver. The best view of this lasted but an instant, but it was unequivocal."

Variation of temperature during the eclipse "not at the excess more than two degrees of Fahrenheit."

NOTICE.

The Plates 1 and 2 belonging to this number have been provided by the Smithsonian Institution, which has already done so much for the attainment of valuable observations upon the eclipse in question. The present number has been delayed on account of the non-arrival of the illustrations. The photographic sheet upon which Professor Bartlett's observations are reproduced, and which will be distributed with the succeeding number, contains his nineteen observations, within the space occupied by one in the original impression, and may be more satisfactorily examined by transmitted than by reflected light. It is hoped that it may prove the pioneer of a new class of accurate and permanently recorded astronomical observations.

G.

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Observations of Euphrosyne and of the Fourth Comet of 1854, made at Cloverden with the Shelby Equatorial, by B. A. Gould, Jr. and Joseph Winlock.
Observations of Comet 1854, IV. and Euphrosyne, made with the Washington Equatorial, by James Ferguson, Esq.
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Notice.

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THE

ASTRONOMICAL JOURNAL.

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PROBLEMS OF SPHERICAL MECHANICS.

By Mr. EDWARD COMBESCURE,
PROFESSOR IN NEW YORK.

§ 1.

1. Let X, Y, Z be the components, relative to three fixed rectangular axes, of the accelerating force R, which acts upon a material point of the unit of mass, and φ, the angle which the direction of R forms with the element ds of the trajectory; we shall have

$$X\,dx + Y\,dy + Z\,dz = R\cos\varphi\,ds$$

where x, y, z designate the rectangular co-ordinates of the material point. On the other hand, if we imagine the space divided into an infinite number of infinitesimal parallelopipeds by three series of orthogonal surfaces of the parameters λ, μ, ν, the force R may be decomposed into three other forces S_1, S_2, S_3, exerted in the directions ds_1, ds_2, ds_3, from M, the vertex actually occupied by the body. This will give us

$$R\cos\phi = S_1\frac{ds_1}{ds} + S_2\frac{ds_2}{ds} + S_3\frac{ds_3}{ds}$$

and consequently,

$$X\,dx + Y\,dy + Z\,dz = S_1\,ds_1 + S_2\,ds_2 + S_3\,ds_3.$$

The sides ds_1, ds_2, ds_3, being of the form $L\,d\lambda$, $M\,d\mu$, $N\,d\nu$, where L, M, N are functions of the variables λ, μ, ν, the first member will be an exact differential, when the expression $S_1\,L\,d\lambda + S_2\,M\,d\mu + S_3\,N\,d\nu$ will be itself an exact differential in reference to the three independent variables λ, μ, ν, if the body is entirely free, or in reference to two of them if it is compelled to move upon a given surface, and one of the variables is eliminated by means of the equation of this surface. In the latter case, if the given surface can be taken for one of those which form part of the co-ordinate system, and which depends on the parameter ν for example, we shall have during the whole of the motion $d\nu = 0$, and the existence of the *function of the forces* will depend on the integrability of the differential

$$S_1\,L\,d\lambda + S_2\,M\,d\mu.$$

When the arcs s_1, s_2, which divide the given surface $\nu =$ const. into infinitesimal rectangles, can be taken for the two independent variables, the existence of the function of the forces will be subordinate to the identity,

$$\frac{dS_1}{ds_2} = \frac{dS_2}{ds_1}.$$

This is what will hold, for example, for developable surfaces, when we take for s_1 and s_2 two series of orthogonal geodetic lines; and by the simple inspection of the equations of analytical mechanics, we shall be led to the conclusion, that every plane figure which admits of a function of forces may be enveloped without modification upon any developable surface whatsoever.

For surfaces of revolution we may choose for s_1 the meridian arcs drawn from the pole, and if the component S_2 constantly tangent to the parallels does not exist, and S_1 only depends upon s_1, the condition of integrability will be evidently satisfied, and, denoting the velocity of the body by v, we shall have

$$v^2 = 2\int S_1\,ds_1$$

which is the canonical form of the equation of living forces, relative to a central force which is a function of the distance. But here we ought to consider the center of action as acting by means of a thread perfectly flexible, and free to slide upon the surface without friction. If, to speak particularly, the surface of revolution is a sphere, it is clear, in consequence of its symmetry, that the equation of living forces will hold good for any number whatever of central *spherical* forces, which are functions of the distance; and denoting by $\varrho_1, \varrho_2, \ldots\ldots \varrho_n$, for the sake of analogy, the arcs of great circles or spherical vectors drawn from the centers of action and terminating at the point, and by $F_1(\varrho_1)$, $F_2(\varrho_2)$, ... $F_n(\varrho_n)$ the intensities of the forces, it will be allowable to write

$$(A.)\qquad v^2 = 2\,\Sigma_{i=1}^{i=n}\int F_i(\varrho_i)\,d\varrho_i.$$

2. As I have the intention of limiting myself to the sphere, the preceding general considerations may be regarded as the preliminaries, though extremely incomplete, of what it would be necessary to do if we desired to investigate the motion of a material point upon any surface whatever, solicited by certain curvilinear forces; for example, the motion of a material point

attracted geodetically upon an ellipsoid by forces emanating from one or several *ombilics*, and functions of the geodetic distances of the body from these points.

Hereafter, to adapt myself completely to the processes of rational mechanics, I denote by a_i, b_i, c_i the rectangular co-ordinates, variable with the time, of the point where the tangent to the vector ϱ_i, at the point where it intersects the trajectory, meets the prolongation of the radius $O\,C_i$ of the sphere drawn through C_i, the fixed center of action on its surface: — I call N the resistance which this same surface occasions, and, having regard to the mode of action of the forces $F_i(\varrho_i)$, am led to write the classic equations,

$$\frac{d^2x}{dt^2} + \Sigma_{i=1}^{i=n} F_i(\varrho_i)\,\frac{a_i - x}{\operatorname{tang}\varrho_i} + Nx = 0$$

$$\frac{d^2y}{dt^2} + \Sigma_{i=1}^{i=n} F_i(\varrho_i)\,\frac{b_i - y}{\operatorname{tang}\varrho_i} + Ny = 0$$

$$\frac{d^2z}{dt^2} + \Sigma_{i=1}^{i=n} F_i(\varrho_i)\,\frac{c_i - z}{\operatorname{tang}\varrho_i} + Nz = 0$$

in which the radius of the sphere is taken as unity. Now the ordinary spherical co-ordinates of the center C_i being represented by $\gamma_i\ \eta_i$, we have

$$a_i = \sec\varrho_i \sin\gamma_i \cos\eta_i\,; \qquad b_i = \sec\varrho_i \sin\gamma_i \sin\eta_i\,; \qquad c_i = \sec\varrho_i \cos\gamma_i\,;$$

and as the point (a_i, b_i, c_i) is situated in the plane tangent to the point (x, y, z) of the sphere actually occupied by the body, we have

$$\sin\gamma_i \cos\eta_i\, x + \sin\gamma_i \sin\eta_i\, y + \cos\gamma_i\, z = \cos\varrho_i$$

whence

$$\sin\gamma_i \cos\eta_i\, dx + \sin\gamma_i \sin\eta_i\, dy + \cos\gamma_i\, dz = -\sin\varrho_i\, d\varrho_i$$

and consequently

$$\frac{a_i - x}{\operatorname{tang}\varrho_i}\,dx + \frac{b_i - y}{\operatorname{tang}\varrho_i}\,dy + \frac{c_i - z}{\operatorname{tang}\varrho_i}\,dz = \frac{a_i\,dx + b_i\,dy + c_i\,dz}{\operatorname{tang}\varrho_i} = -\,d\varrho_i.$$

We shall then still obtain the equation (A) of living forces.

Eliminating N between the first two of the equations (1), and denoting by ϱ and ω the spherical vector from the axis of z, and the angle which this makes with the prime meridian, the following equation will be formed, which may replace one of the primitive ones.

$$(B.)\qquad \frac{d}{dt}\left(\sin^2\varrho\,\frac{d\omega}{dt}\right) = \Sigma_{i=1}^{i=n} F_i(\varrho_i)\sin\gamma_i \sin(\omega - \eta_i).$$

Finally, by multiplying the equations (I) by x, y, z, and adding, it will be verified that the pressure N is equal in its absolute value to the square of the velocity.

3. When only one center of action exists, placing this center at the origin of ϱ, the equations (A) and (B) will become

$$(a.)\qquad \frac{ds^2}{dt^2} = 2\int F\varrho\, d\varrho$$

$$(b.)\qquad \sin^2\varrho\; d\omega = c\; dt$$

ds being always the element of the trajectory, and c the constant of the areas. Hence by the elimination of dt, and putting $\operatorname{cotang}\varrho = u$, we obtain

$$(c.)\qquad \frac{du^2}{d\omega^2} + 1 + u^2 = \frac{2}{c^2}\int F\varrho\, d\varrho$$

which will, by quadrature, determine the trajectory when $F\varrho$ is given, or reciprocally will afford the value of $F\varrho$ by means of the given equation of the trajectory. Differentiating the equation (c) in general, it gives

$$\frac{d^2u}{d\omega^2} + u = \frac{1}{c^2}\,F\varrho\,\frac{d\varrho}{du} \quad \text{or}$$

$$(c'.)\qquad \frac{d^2u}{d\omega^2} + u = -\frac{1}{c^2}\sin^2\varrho\; F\varrho$$

an equation which in certain cases can replace with advantage the one from which it is derived, for the double use of which this latter is susceptible. It is the equation which corresponds upon the sphere to the one which M. Binet has made known for the plane.

Let p be the spherical perpendicular let fall from the origin of ϱ upon the great circle tangent to the trajectory, and μ the inclination of this great circle, or spherical tangent, to the vector ϱ, the right-angled triangle which it will form gives

$$\frac{\sin p}{\sin\varrho} = \sin\mu$$

and as

$$\sin\mu = \frac{\sin\varrho\; d\omega}{ds}$$

there results

$$\frac{ds}{dt} = \frac{\sin^2\varrho}{\sin p}\,\frac{d\omega}{dt}$$

or, having regard to the equation of areas,

$$(d.)\qquad v = \frac{ds}{dt} = \frac{c}{\sin p}$$

so that *in every central motion produced by a spheric force which is a function of the distance, the velocity is in the inverse ratio of the sine of the (spheric) perpendicular, let fall from the center of action upon the (spheric) tangent to the trajectory.*

The last equation being squared, and the first member eliminated by means of the equation of living forces, we have

$$(e.)\qquad \frac{c^2}{\sin^2 p} = 2\int F\varrho\, d\varrho\,.$$

4. If at all the points of a curve traced upon any surface, we draw geodetic normals to this curve, all these geodetic lines will successively intersect, and the series of their points of intersection will form another curve, which can be called the *geodetic evolute* of the first. It is evident, indeed, that if a thread of convenient length be wound round this evolute, its extremity will describe, in unwinding, the curve under consideration, and all its other points will describe parallel curves which will also be geodetic involutes of the evolute. It is evident, moreover, that the arc of the evolute is exactly equal to the difference of the geodetic tangents drawn through the extrem-

ities and terminating at the involute. But it will be found that, contrary to what holds for the plane, one and the same curve will generally admit of several geodetic evolutes. When the curve is spheric, the geodetic evolute being, upon the sphere, the locus of the poles of the osculating circles, each of its points might be denominated the *spheric center of curvature*, and the arc which joins it normally to the curve, the *spheric radius of curvature*, — for the corresponding point of the curve. Moreover, this spheric radius of curvature is precisely the arc which measures the inclination of the osculating plane to the tangent plane, — and its sine is nothing else than the ordinary radius of curvature. The spheric evolute is then the mathematically correct image of the successive variation of the two reflections undergone by the consecutive elements of every curve traced on the surface of a sphere. Its consideration is fundamental in the study of spheric curves, in which it plays a more complex part than the plane evolute in the study of plane curves.

Let F be the origin of ϱ; M, M', two consecutive points of the spheric curve; I, the point on the concave side where the two spheric normals $M\,I$, $M'\,I$ meet. I will then be the spheric center of curvature answering to the point M; $M\,I = M'\,I = R$, the spheric radius of curvature; and if the vector $F\,I$ be denoted by δ, the angle which it forms with the prime meridian by θ, and it be borne in mind that μ is the angle which the tangent makes with ϱ, the consideration of the two triangles $F.I\,M$, $F.I\,M'$ gives immediately,

$$\frac{\sin R}{\sin\delta} = \frac{\sin(\theta-\omega)}{\cos\mu} = \frac{\sin(\theta-\omega-d\omega)}{\cos(\mu+d\mu)}$$

whence

$$\frac{\sin(\theta-\omega-d\omega)-\sin(\theta-\omega)}{\cos(\mu+d\mu)-\cos\mu} = \frac{\sin(\theta-\omega)}{\cos\mu}$$

that is,

$$\frac{\cos(\theta-\omega)\,d\omega}{\sin\mu\,d\mu} = \frac{\sin(\theta-\omega)}{\cos\mu}$$

whence we obtain

$$\text{cotang}\,(\theta-\omega) = \text{tang}\,\mu\,\frac{d\mu}{d\omega} \tag{α}$$

which, since $\text{tang}\,\mu = \frac{\sin\varrho\,d\omega}{d\varrho}$, may also be written

$$\text{cotang}\,(\theta-\omega) = \frac{\sin\varrho\,d\mu}{d\varrho}. \tag{α'}$$

We have also in the same triangle $F\,I\,M$

$$\text{cotang}\,R = \frac{\cos\varrho\sin\mu + \cos\mu\,\text{cotang}\,(\theta-\omega)}{\sin\varrho}$$

or, by the last equality,

$$\text{cotang}\,R = \frac{d\,.\sin\varrho\sin\mu}{\sin\varrho\,d\varrho}. \tag{β}$$

Finally, we may take,

$$\sin\delta = \frac{\sin R\cos\mu}{\sin(\theta-\omega)}. \tag{γ}$$

The formulas (α, α'), (β), (γ), are then capable of furnishing every thing relative to the spheric evolutes, inasmuch as they determine the radius R and the co-ordinates θ, δ, of the spheric center of curvature.

Denoting, as in No. 3, by p the spheric perpendicular let fall from F upon the tangent, we have

$$\sin p = \sin\varrho\sin\mu$$

and the equation (β) may therefore be written

$$\text{cotang}\,R = \frac{d\sin p}{\sin\varrho\,d\varrho} \tag{β'}$$

and if we have regard successively to the equations (d) and (e) of that number, we shall obtain the new forms

$$\text{cotang}\,R = \frac{c\,d\frac{1}{v}}{\sin\varrho\,d\varrho} \tag{β''}$$

$$\text{tang}\,R = \frac{\pm\sin\varrho}{c\,F(\varrho)}\left(2\int F\varrho\,d\varrho\right)^{\frac{3}{2}} \tag{β'''}$$

which by virtue of (c) and (c') give in their turn by the elimination of $F(\varrho)$

$$\text{tang}\,R = \frac{\left(1+\frac{1}{1+u^2}\cdot\frac{d\,u^2}{d\,\omega^2}\right)^{\frac{3}{2}}}{\frac{d^2\,u}{d\,\omega^2}+u}. \tag{β^{IV}}$$

If at the two consecutive points I and I_1 of the evolute, we draw two spherical normals intersecting in I' the spheric center of curvature of this evolute, the tangents to these two arcs at I_1 will form with one another an angle $d\,\xi$, and if we call R' the spheric radius of curvature $I\,I'$, and observe that $I\,I_1 = d\,R$, we shall have

$$\sin R' = \frac{d\,R}{d\,\xi}.$$

Now $d\,\xi$ is manifestly equal to the angle of contact of the first evolute and of the involute itself, so that

$$d\,\xi = \frac{d\,s}{\sin R}$$

and consequently,

$$\sin R' = \frac{\sin R\,d\,R}{d\,s}$$

which will enable us to find the spheric radius of curvature of the successive evolutes of any spheric curve.

4′. Let us take a perfectly flexible and inextensible thread, and suppose it submitted upon the sphere to the influence of central spheric forces $f_i\,(\varrho_i)$ referred to the unit of length. Retaining the same notation as in No. 2, the equations of equilibrium of this thread will be obtained by replacing the first terms of the equations (1) by

$$-\frac{d\,.\,T\frac{d\,x}{d\,s}}{d\,s}, \quad -\frac{d\,.\,T\frac{d\,y}{d\,s}}{d\,s}, \quad -\frac{d\,.\,T\frac{d\,z}{d\,s}}{d\,s},$$

in which T denotes the tension, and by substituting f_i for F_i. Then the same calculations which have conducted us to the equations (A) and (B) will give

$$T = -\Sigma_{i=1}^{i=n}\int f_i\,(\varrho_i)\,d\,\varrho_i \tag{A.}$$

$$d\,.\,T\sin^2\varrho\,\frac{d\,\omega}{d\,s} = -\Sigma_{i=1}^{i=n} f_i\,(\varrho_i)\sin\gamma_i\sin(\omega-\eta_i)\,d\,s. \tag{B.}$$

This last equation can also be written

(B.) $$d\,T \sin p = -\Sigma_{i=1}^{i=n} f_i(\varrho_i) \sin \gamma_i \sin(\omega - \eta_i)\, d s.$$

If only one center of action exists, by placing this at the origin of the co-ordinates ϱ and ω, we shall have $\gamma_i = 0$, and the preceding equations will give

(a.) $$T = -\int f(\varrho)\, d\varrho$$

(b.) $$T \sin p = +A$$

A representing an arbitrary constant. From these results the equation

(c.) $$\frac{A}{\sin p} = -\int f(\varrho) \cdot d\varrho\,;$$

an equation which will determine the figure of equilibrium when $f\varrho$ is given, or reciprocally. We shall thus obtain for the spheric radius of curvature,

$$\text{tang } R = \frac{+\sin\varrho \left\{\int f(\varrho)\, d\varrho\right\}^2}{A f(\varrho)}.$$

If the curve of equilibrium determined by the function $f(\varrho)$ is to coincide with the trajectory dependent upon $F\varrho$, it is requisite (ϱ and ds being supposed, both in No. 2 and in the present section, to refer to one and the same curve) that the expressions for $\sin p$ should be the same in each case; which gives by the comparison of the equations (e) and (e).

$$\int f(\varrho)\, d\varrho = -\frac{A}{c} \left\{2\int F(\varrho)\, d\varrho\right\}^{\frac{1}{2}}$$

whence

$$f\varrho = +\frac{A}{c} \frac{F(\varrho)}{\left\{2\int F(\varrho)\, d\varrho\right\}^{\frac{1}{2}}},$$

$$F\varrho = \frac{c^2}{A^2} f(\varrho) \int f(\varrho)\, d\varrho.$$

This relation being assumed to exist, the tension will be proportional to the velocity v.

Having thus established, in regard to central spheric forces, formulas which comprise those which refer to the plane, in absolutely the same manner as spherical triangles comprise rectilinear triangles, and would themselves be comprised in elliptico-geodetic ones, it appears to me both natural and useful to make of these formulas some simple applications.

5. One of the most simple hypotheses which can be made concerning the law of central forces is that which reduces the equation (c') to the linear form; i. e. that for which we have

$$-\frac{\sin^2\varrho\, F(\varrho)}{c^2} = K + h u$$

which gives

$$F(\varrho) = -c^2 \left\{\frac{K}{\sin^2\varrho} + \frac{h \cos\varrho}{\sin^3\varrho}\right\}.$$

The equation (c') then becomes, by making $1 - h = \pm n^2$,

$$\frac{d^2 u}{d\omega^2} \pm n^2 u = K.$$

Hence we deduce as the equation of the trajectory,

(f.) (*lower sign*) $$\text{cotang } \varrho = -\frac{K}{n^2} + A\, e^{n\omega} + B\, e^{-n\omega}$$

(g.) (*upper sign*) $$\text{cotang } \varrho = \frac{K}{n^2} + A' \cos n(\omega - \omega_0)$$

A, B, A', ω_0, being the constants of the integration.

As these constants may be determined without difficulty from the initial circumstances, we may consider them as quantities perfectly known, and proceed to the investigation of the finite equations which connect the time and the co-ordinates.

I will confine myself at first to the first form, and consider the special case in which one of the constants A and B, the second, for example, is equal to zero, so that, by making $-\frac{K}{n^2} = \text{cotang } \alpha$, the equation of the trajectory will be reduced to

$$u = \text{cotang } \varrho = \text{cotang } \alpha + A\, e^{n\omega}$$

where, assuming $A = e^{n\eta}$, and revolving the polar axis of the angle η,

$$u = \text{cotang } \varrho = \text{cotang } \alpha + e^{n\omega}.$$

Hence we deduce,

$$n\, d\omega = \frac{d u}{u - \text{cotang } \alpha}$$

and the equation of the areas $c\, d t = \sin^2\varrho\, d\omega$ gives, in consequence,

$$n\, c\, d t = \frac{d u}{(1 + u^2)(u - \text{cotang } \alpha)}$$

$$= \sin\alpha \left\{\frac{\sin\alpha\, d u}{u - \text{cotang } \alpha} - \frac{\sin\alpha\, u\, d u}{1 + u^2} - \frac{\cos\alpha\, d u}{1 + u^2}\right\}$$

from which, by integrating and putting $\frac{n c}{\sin\alpha} = n'$,

$$n' t = \sin\alpha\; l \frac{u - \text{cotang } \alpha}{\sqrt{1 + u^2}} + \cos\alpha \text{ arc } [\text{cotang} = u] + \text{const.}$$

or calling ϱ_0 the value of ϱ for $t = 0$,

$$n' t = \sin\alpha\; l \frac{\sin(\alpha - \varrho)}{\sin(\alpha - \varrho_0)} + (\varrho - \varrho_0) \cos\alpha.$$

If, as an especial case, $\alpha = \frac{1}{2}\pi$, so that $\text{cotang } \varrho = e^{n\omega}$, we shall have $\cos\varrho = \cos\varrho_0\, e^{cnt}$, and moreover,

$$F(\varrho) = -\frac{c^2 h \cos\varrho}{\sin^3\varrho}.$$

The body would then reach the equator after an infinite time if $c n$ is negative, and the pole at the end of the finite time $\frac{1}{c n}\, l . \sec\varrho_0$ if $c n$ is positive. As it is easy to see the mechanical peculiarities which hold in this circumstance, I will refrain from entering with any detail upon this subject, as also in all that follows.

Neither of the constants A and B being zero, if we make

$$A = \tfrac{1}{2}\, b\, e^{n\eta}, \qquad \pm B = \tfrac{1}{2}\, b\, e^{-n\eta},$$

and therefore

$$b = \pm 2\sqrt{(\pm A B)}, \qquad \eta = \frac{1}{2n}\, l \left(\pm \frac{A}{B}\right),$$

the equation (f) will, after the polar axis of the angle η shall have been made to revolve, assume the ambiguous form

$$\text{cotang } \varrho = a + b\, \frac{e^{n\omega} \pm e^{-n\omega}}{2}$$

the upper sign corresponding to the case in which A and B

have the same sign, and the lower to that in which their signs are opposite. Moreover, we have put $-\frac{K}{n^2} = a$.

Let us consider each of these cases separately.

1st. The equation of the trajectory is

$$\cot.\varrho = a + b\,\frac{e^{n\omega} - e^{-n\omega}}{2}.$$

I make

$$a = \pm\sqrt{(A^2-1)\,(1-B^2)} \qquad b = A\,B,$$

A and B being two new coefficients intended to replace a and b. I make besides

$$\frac{e^{n\omega} - e^{-n\omega}}{2} = \operatorname{tang}\phi\,; \quad \text{whence}\ \frac{e^{n\omega} + e^{-n\omega}}{2} = \frac{1}{\cos\varphi}$$

$$n\,d\,\omega = \frac{d\varphi}{\cos^2\varphi} : \frac{e^{n\omega} + e^{-n\omega}}{2} = \frac{d\varphi}{\cos\varphi}$$

and also

$$\operatorname{cotang}\varrho = \pm\sqrt{(A^2-1)\,(1-B^2)} + A\,B\operatorname{tang}\varphi.$$

From this last equation, we deduce

$$\sin^2\varrho = \frac{\cos^2\varphi}{\frac{A^2+B^2}{2} + \frac{A^2+B^2-2\,A^2\,B^2}{2}\cos 2\,\phi \pm A\,B\sqrt{(A^2-1)\,(1-B^2)}\sin 2\,\phi}.$$

The sum of the squares of the coefficients of cos 2 φ and sin 2 φ reducing itself to $\frac{1}{4}\,(A^2 - B^2)^2$, we can make

$$\frac{A^2+B^2-2\,A^2\,B^2}{A^2-B^2} = \cos 2\,\alpha \qquad \frac{\pm 2\,A\,B\sqrt{(A^2-1)\,(1-B^2)}}{A^2-B^2} = \sin 2\,\alpha$$

and shall obtain

$$\sin^2\varrho = \frac{\cos^2\varphi}{\frac{A^2+B^2}{2} + \frac{A^2-B^2}{2}\cos 2\,(\varphi-\alpha)}.$$

The equation of the areas $c\,d\,t = \sin^2\varrho\,d\,\omega$ will then become, having regard to the value of $d\,\omega$ given above,

$$c\,n\,d\,t = \frac{\cos\varphi\,d\,\varphi}{\frac{A^2+B^2}{2} + \frac{A^2-B^2}{2}\cos 2\,(\varphi-\alpha)}$$

or, putting $\varphi - \alpha = \varphi'$,

$$c\,n\,d\,t = \frac{\cos\alpha\cos\varphi'\,d\,\varphi' - \sin\alpha\sin\varphi'\,d\,\varphi'}{\frac{A^2+B^2}{2} + \frac{A^2-B^2}{2}\cos 2\,\varphi'}.$$

This can also be written

$$c\,n\,d\,t = \frac{\cos\alpha\,d\sin\varphi'}{A^2-(A^2-B^2)\sin^2\varphi'} + \frac{\sin\alpha\,d\cos\varphi'}{B^2+(A^2-B^2)\cos^2\varphi'}$$

and finally, making $B = A\cos\varepsilon$, $A^2\sin\varepsilon\,c\,n = n'$

$$n'\,d\,t = \frac{\cos\alpha\,d.\sin\varepsilon\sin(\varphi-\alpha)}{1-\sin^2\varepsilon\sin^2(\varphi-\alpha)} + \frac{\sin\alpha}{\cos\varepsilon}\,\frac{d.\operatorname{tang}\varepsilon\cos(\varphi-\alpha)}{1+\operatorname{tang}^2\varepsilon\cos^2(\varphi-\alpha)}.$$

(*To be continued.*)

OBSERVATIONS OF PSYCHE AND URANIA, MADE AT THE HAMBURG OBSERVATORY.

By PROFESSOR CHARLES RÜMKER.

PSYCHE.

1854.	Hamburg M. T.	⑯ α	Log. Factor Parallax.	⑯ δ	Log. Fact. Parallax.	No. Comp.	Comparison-Stars.
	h. m. s.	° ′ ″		° ′ ″			
July 25	11 54 34.5	301 51 54.6		—17 47 21.5	9.9761	3	*a, b, c.*
26	10 36 47.5	301 39 49.7	*n*9.2917	17 50 45.8	9.9721	5	*b, c.*
30	10 16 40.2	300 49 45.0	*n*9.2983	18 4 55.0	9.9725	3	*d, e.*
Aug. 1	10 17 1.1	300 24 54.0	*n*9.9739	18 12 46.7	9.9739	9	*d.*
4	10 42 26.5	299 48 37.4	*n*8.8216	—18 23 17.9	9.9772	2	*f.*

Apparent Places of Comparison-Stars.

Date.	*	α	δ	Date.	*	α	δ
		h. m. s.	° ′ ″			h. m. s.	° ′ ″
July 25	*a*	20 10 6.70	—18 0 59.9	July 30	*d*	20 2 56.40	—18 14 50.9
"	*b*	20 11 25.15	17 56 26.5	"	*c*	20 5 39.50	18 6 51.0
"	*c*	20 11 48.91	—17 57 4.8	Aug. 4	*f*	19 58 37.42	—18 14 25.2

URANIA.

1854.	Hamburg M. T.	㉚ α	Log. Factor Parallax.	㉚ δ	Log. Fact. Parallax.	No. Comp.	Comparison-Stars.
	h. m. s.	° ′ ″		° ′ ″			
Aug. 12	10 2 54.0	312 21 21.0	n9.3429	—17 21 35.2	9.9697	10	*a, b.*
13	9 38 25.9	312 6 48.1	n9.4305	17 24 14.3	9.9720	8	*a, b, c.*
14	9 58 30.7	311 52 14.3	n9.3149	17 26 51.8	9.9706	4	*c, d.*
19	9 38 24.6	310 42 18.2	n9.2918	17 39 25.8	9.9716	5	*e, f, c.*
22	10 4 40.0	310 3 2.7	n8.9122	17 46 11.2	9.9700	4	*g, h, i.*
26	10 25 33.4	309 15 48.2	8.3250	17 54 3.9	9.9764	7	*g, h.*
31	9 17 46.7	308 26 19.1	n9.0038	18 1 10.6	9.9756	10	*j, k.*
Sept. 1	9 17 54.0	308 17 31.3	n8.9479	—18 2 17.3	9.9759	11	*j, k.*

Apparent Places of Comparison-Stars.

Date.	⁎	α	δ	Date.	⁎	α	δ
		h. m. s.	° ′ ″			h. m. s.	° ′ ″
Aug. 12	*a*	20 50 11.04	—17 34 28.6	Aug. 22	*g*	20 38 21.80	—17 41 23.0
"	*b*	20 51 17.00	17 26 23.3	"	*h*	20 38 54.51	17 41 56.9
13	*c*	20 47 35.63	17 39 45.8	"	*i*	20 43 17.53	18 2 32.6
14	*d*	20 47 58.57	17 47 43.3	31	*j*	20 33 4.42	18 6 41.2
19	*e*	20 45 4.80	17 51 38.8	"	*k*	20 33 4.89	—17 53 25.9
"	*f*	20 45 34.49	—17 46 57.5				

OBSERVATIONS OF THE COMET 1854, III., MADE AT THE HAMBURG OBSERVATORY.

By Mr. GEORGE RÜMKER.

1854.	Hamburg M. T.	☄ α	Log. Fact. Parallax.	☄ δ	Log. Fact. Parallax.	No. of Obs.	Comparison Stars.
	h. m. s.	° ′ ″		° ′ ″			
July 17	10 56 29.4	152 3 42.2	9.7748	+37 36 49.0	9.9334	6	*a.*
18	10 47 25.2	152 51 56.9	9.7823	36 35 17.6	9.9295	4	*b, e.*
19	10 19 55.0	153 36 33.2	9.8084	35 36 24.2	9.9135	6	*d.*
21	10 21 20.0	154 58 38.2	9.7943	+33 40 51.6	9.9200	7	*e.*

Apparent Places of Comparison-Stars.

Date.	⁎	α	δ	Date.	⁎	α	δ
		h. m. s.	° ′ ″			h. m. s.	° ′ ″
July 17	*a*	10 19 25.72	+37 27 22.2	July 19	*d*	10 14 37.60	+35 57 20.4
18	*b*	10 18 9.16	36 38 16.7	21	*c*	10 19 11.99	+33 47 6.0
"	*c*	10 19 9.10	+36 41 24.1				

NEW PLANETS. — CIRCULAR.

Through the politeness of Mr. Bond, the Editor has received observations of two new asteroids, communicated by Mr. LeVerrier. Both were discovered in Paris, the former by Mr. Goldschmidt, the latter by Mr. Chacornac.

POMONA.

1854.	Paris M. T.	㉜ α	㉜ δ	
	h. m. s.	m. s.	′ ″	
Oct. 28	13 18 10	*a* — 6 33.94	*a* + 3 34.8	
29	11 51 52	*b* + 7 1.80		
	13 3 49		*b* — 6 0.2	
29	11 51 40.1	2ʰ 23 33.03		Mer.
30	11 46 50.6	2 22 39.34		"

Comparison-Stars.

	⁎ α	⁎ δ
	h. m. s.	° ′ ″
a	2 30 55	+14 51 30
b	2 16 32.85	+14 55

These places are approximate, except the right-ascension of *b*, which was obtained by meridian observation.

POLYMNIA.

1854.	Paris M. T.	㉝ α	㉝ δ	
	h. m. s.	h. m. s.	° ′ ″	
Oct. 28	16 17 24.3	2 33 55.38	+16 58 45.3	Eq.
29	12 1 14.5	2 33 8.97	16 55 56.9	Mer.
30	11 56 22.3	2 32 12.58	+16 52 32.8	"

B. A. GOULD, Jr.

Cambridge, 1854, *November* 18.

FROM A LETTER OF PROFESSOR ARGELANDER TO THE EDITOR.

Bonn, 1854, *November* 4.

So far as the weather has allowed, I have observed the new planet [*Euphrosyne*] as well as the last comet, of which Mr. Klinkerfues was the first discoverer,* and I inclose you my observations of each. You will already have heard of the discovery of the two newest planets, *Pomona* by Goldschmidt on the 26th, and *Polymnia* by Chacornac on the 28th of October. For security, however, I inclose them also. …… The star *b* compared with *Pomona*, October 29, is Weisse II. 255. *Pomona* is of the 10.11, *Polymnia* of the 9.10 magnitude. The latter I observed yesterday on the meridian, but very unsatisfactorily on account of the clouds. I obtained

1854.	M. T. Bonn.	㉝ α	㉝ δ
	h. m. s.	h. m. s.	° ′ ″
Nov. 3	11 37 27	2 18 26.6	+16 38 31

Pomona could not be seen on account of the bright moonshine and misty atmosphere.

I propose shortly to send you those minima of *Algol* which will be visible in America during the coming year, — and will beg you to use your exertions to have as many observations as possible made upon them, — that we may learn something more of this interesting star.

FR. ARGELANDER.

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* This comet seems to have had at least six independent discoverers; Mr. Klinkerfues in Göttingen on the 11th, Mr. Bruhns in Berlin on the 12th, Mr. Van Arsdale in Newark on the 13th, Miss Mitchell in Nantucket and Mr. Donati in Florence on the 18th, and Mr. Gussew in Wilna on the 21st of September. — G.

EUPHROSYNE.

1854.	Bonn M. T.	㉛ α	㉛ δ	No. of Obs.	Comp. Stars.
	h. m. s.	h. m. s.	° ′ ″		
Sept. 29	13 54 33.3	23 23 47.6	—2 31 23.6	6	α
30	11 27 48.2	23 10 41.9	33 19.7	4	α
"	11 46 30.7	23 10 18.9	33 18.1	6	β
Oct. 1	11 3 6.1	22 55 51.9	32 8.3	8	γ
2	11 7 59.7	22 40 49.1	2 30 48.3	8	γ
21	11 35 16.6	17 38 53.4	1 50 41.2	8	δ
22	11 42 19.8	17 17 14.7	47 42.7	6	ε
"	11 58 58.0	17 17 5.1	47 24.6	1	ζ
23	11 19 36.9	17 1 11.5	—1 44 21.1	9	ζ
Oct. 26	12 15 58.6	16 13 22.4	—1 33 46.1	6	η
"	12 25 49.2	16 13 27.1	33 36.6	5	θ
27	9 55 20.4	15 59 23.2	30 24.1	4	η
"	10 11 12.0	15 59 26.6	30 19.2	5	θ
28	10 9 46.0	15 41 11.5	26 33.4	8	θ
29	10 50 42.9	15 28 35.6	22 27.2	9	ι
30	9 55 16.5	15 14 19.8	18 33.0	8	ι
31	10 19 26.6	14 59 28.5	14 19.8	6	ι
"	10 32 32.4	14 59 24.3	—1 14 10.2	4	κ

The observations of October 1 and 2 are by Dr. Schönfeld, the others by myself. The positions will be slightly changed by correction of the star places.

COMET 1854, IV.

1854.	Bonn M. T.	☄ α	☄ δ	No. of Obs.	Comparison-Stars.	∗ α	∗ δ
		° ′ ″	° ′ ″			° ′ ″	° ′ ″
Sept. 16	10 43 12.6	138 20 43.2	+72 0 33.1	5	Z. 195, 19	138 26 42.7	+72 3 5.3
18	11 50 15.7	145 33 17.9	69 55 53.6	6	" 106, 11; 176, 18	145 44 14.7	69 34 56.7
20	8 15 55.6	150 51 32.5	67 51 29.6	4	" 106, 24; 176, 45, 48	150 16 29.0	67 55 17.9
21	9 14 56.7	153 25 11.0	66 38 23.3	8	" 176, 59, 61	153 37 35.0	66 38 39.8
22	9 26 32.4	155 39 15.0	65 25 52.4	6	" 104, 60	155 18 37.9	65 25 16.7
27	7 41 30.2	163 57 39.5	59 17 40.7	10	" 97, 101; 102, 125	163 20 40.6	59 26 53.0
28	7 22 9.4	165 13 47.0	58 2 49.4	8	" 97, 116	165 48 14.7	58 4 17.3
29	7 37 9.5	166 26 20.1	56 45 59.1	6	" 97, 117; 103, 10	166 3 57.0	57 11 39.3
30	7 31 32.6	167 32 5.7	55 30 0.2	4	" 100, 17	167 40 26.1	55 26 43.0
Oct. 2	7 4 38.3	169 30 28.4	52 59 42.3	8	" 95, 95	169 26 9.9	+52 55 57.2
"	8 18 12.7	169 33 21.4	+52 55 38.8	7	" "		

The last comparison-star, Z. 95, No. 95, occurs twice in Lalande, which positions show that for this star the time is given in the Zones 1^s too little.

OBSERVATIONS OF PROSERPINA AND URANIA.

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By JAMES FERGUSON.

[Communicated by Lieutenant Maury. — Corrected for refraction.]

PROSERPINA.

Date.	Washington M. T.	No. of Comp.	Comparison-Star.	㉖ — *		㉖'s apparent	
				Δα	Δδ	α	δ
1854.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Aug. 22	11 1 35.4	4	Weisse XXII. 1276	—0 18.30	+14 36.40	23 0 26.18	—12 8 25.98
29	11 10 16.4	7	" 1204	—2 24.30	+14 40.87	22 54 28.92	12 42 56.18
30	11 10 34.2	5	" 1204	—3 16.65	+10 5.48	22 53 36.58	12 47 31.48
Sept. 1	10 0 38.6	8	B. A. C. 7976	+5 26.24	+ 0 54.45	22 51 54.02	12 56 39.82
2	9 57 27.3	5	"	+4 33.70	— 3 21.10	22 51 1.53	13 0 57.12
12	8 30 54.9	14	Weisse XXII. 899	—0 24.25	—14 41.14	22 42 29.14	13 42 3.85
"	9 31 17.2	3	" 899	—0 26.53	—14 49.87	22 42 26.86	13 42 12.58
29	8 42 20.3	10	" 629	+0 24.81	—16 16.07	22 30 34.84	14 23 41.63
30	8 52 30.7	8	" 629	—0 6.50	—17 25.79	22 30 3.50	14 24 52.21
Oct. 7	7 44 13.5	10	" 506	+2 37.91	— 7 43.60	22 27 2.45	14 28 11.96
8	7 44 16.4	6	" 506	+2 17.76	— 7 33.83	22 26 42.29	—14 28 1.97

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XXII. 1276	9	23 0 29.36	—12 24 53.88	Weisse's Catalogue.
" 1204	8	22 56 37.99	12 59 8.25	
B. A. C. 7976	7	22 46 12.45	12 59 4.04	B. A. C. ; Madras Catal. ; Weisse's Catalogue.
Weisse XXII. 899	(8.9)	22 42 37.97	13 28 51.87	Weisse's Catalogue.
" 629	(8.9)	22 29 54.61	14 8 52.40	
" 506	8	22 24 9.08	—14 21 52.82	

URANIA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉚ — *		㉚'s apparent	
				Δα	Δδ	α	δ
	h. m. s.			m. s.	′ ″	h. m s.	° ′ ″
1854, Oct. 19	8 22 52.2	10	Argel. Z. 249, 89	+0 7.69	+0 2.89	20 43 3.37	—16 57 0.16

Adopted Mean Place, 1850.0, *of Comparison-Star.*

*	α	δ
	h. m. s.	° ′ ″
Arg. Z. 249, 89	20 42 40.09	—16 57 59.10

CORRECTION TO BABBAGE'S LOGARITHM TABLES.

Mr. Boyden communicates the following : —

No. 102467, Log is printed 01058192, instead of 01058402.

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PROBLEMS OF SPHERICAL MECHANICS.

By Mr. EDWARD COMBESCURE,

PROFESSOR IN NEW YORK.

(*Continued from page* 45.)

We shall then have by integration,

$$n'(t+\iota) = \tfrac{1}{2}\cos\alpha\, l.\, \frac{1+\sin\varepsilon\sin(\varphi-\alpha)}{1-\sin\varepsilon\sin(\varphi-\alpha)} + \frac{\sin\alpha}{\cos\varepsilon}\,\text{arc}\,[\text{tang} = \text{tang}\,\varepsilon\cos(\varphi-\alpha)]$$

the constant ι being such that for $t=0$ we have $\varphi=\alpha$, which gives

$$n'\iota = \frac{\varepsilon\sin\alpha}{\cos\varepsilon}.$$

And by introducing another auxiliary quantity by the relation tang ε cos $(\varphi-\alpha) =$ tang ψ, we should obtain this second form

$$n'(t+\iota) = \tfrac{1}{2}\cos\alpha\, l\, \frac{\cos\psi+\sqrt{\sin(\varepsilon+\psi)\sin(\varepsilon-\psi)}}{\cos\psi-\sqrt{\sin(\varepsilon+\psi)\sin(\varepsilon-\psi)}} + \frac{\sin\alpha}{\cos\varepsilon}\cdot\psi$$

which may be varied in many ways.

By putting $\phi = \frac{1}{2}\pi$ we should have for the time required for the body to attain the pole, after an infinite number of revolutions,

$$n'(T+\iota) = \tfrac{1}{2}\cos\alpha\, l\, \frac{1+\sin\varepsilon\cos\alpha}{1-\sin\varepsilon\cos\alpha} + \frac{\sin\alpha}{\cos\varepsilon}\,\text{arc}\,[\text{tang} = \text{tang}\,\varepsilon\sin\alpha].$$

Did we desire to know the spherical area contained between a given fixed radius-vector ϱ_0, the variable radius ϱ, and the arc which they intercept, it will be remarked that the indefinite expression for an area of this kind being

$$\int(1-\cos\varrho)\,d\omega$$

we should obtain for the portion A, limited as above mentioned,

$$A = \omega-\omega_0 - \int_{\omega_0}^{\omega}\cos\varrho\,d\,\omega.$$

Now the preceding expressions for cotang ϱ and sin ϱ give

$$\cos\varrho = \text{cotang}\,\varrho\sin\varrho = \frac{\pm\sqrt{(A^2-1)(1-B^2)}\cos\varphi + A\,B\sin\varphi}{\sqrt{A^2-(A^2-B^2)\sin^2\varphi'}}$$

where $\varphi' = \varphi-\alpha$. We shall then have

$$n\cos\varrho\,d\omega = \pm\sqrt{(A^2-1)(1-B^2)}\,\frac{d\,\varphi'}{\sqrt{A^2-(A^2-B^2)\sin^2\varphi'}} + A\,B\,\frac{\sin(\varphi'+\alpha)}{\cos(\varphi'+\alpha)}\,\frac{d\,\varphi'}{\sqrt{A^2-(A^2-B^2)\sin^2\varphi'}}.$$

The last term may be written

$$A\,B\,\frac{\sin 2\varphi'+\sin 2\alpha}{\cos 2\varphi'+\cos 2\alpha}\,\frac{d\,\phi'}{\sqrt{A^2-(A^2-B^2)\sin^2\varphi'}}$$

which may be divided into two portions, one of which is integrable, and gives

$$-\tfrac{1}{2}\,l\,\frac{A\,B+\sqrt{A^2-(A^2-B^2)\sin^2\varphi'}}{A\,B-\sqrt{A^2-(A^2-B^2)\sin^2\varphi'}} = -\Phi.$$

The whole of the remaining parts, namely,

$$\pm\sqrt{(A^2-1)(1-B^2)}\,\frac{d\varphi'}{\sqrt{A^2-(A^2-B^2)\sin^2\varphi'}} + \frac{A\,B\sin 2\alpha}{\cos 2\varphi'+\cos 2\alpha}\cdot\frac{d\varphi'}{\sqrt{A^2-(A^2-B^2)\sin^2\varphi'}}$$

will reduce itself, when we avail ourselves of the expressions of sin α cos α in A and B, to

$$\frac{\sin 2\alpha}{2\,A\,B}\,\frac{\sqrt{A^2-(A^2-B^2)\sin^2\varphi'}}{\cos^2\alpha-\sin^2\varphi'}\,d\varphi'$$

or

$$\frac{\sin 2\alpha}{2\,A\cos\varepsilon}\,\frac{\sqrt{1-\sin^2\varepsilon\sin^2\varphi'}}{\cos^2\alpha-\sin^2\varphi'}\,d\varphi'$$

an expression which by the substitution

$$\text{cotang}\,\varphi' = \cos\varepsilon\,\text{tang}\,\psi$$

becomes

$$\frac{\text{cotang}\,\alpha\cos\varepsilon}{A}\,\frac{d\psi}{(1-\sin^2\gamma\,\text{cotang}^2\alpha\sin^2\psi)\sqrt{1-\sin^2\varepsilon\sin^2\psi}}$$

in which $\cos\gamma = \sin\varepsilon\cos\alpha$. The combination of these partial results then gives, if we make $\Omega = \omega-\omega_0+\Phi-\Phi_0$, and suppose that A commences with ψ,

$$A = \Omega - \frac{\operatorname{cotang} \alpha \cos \varepsilon}{A} \int_0^{\psi} \frac{d\psi}{(1 - \sin^2 \gamma \operatorname{cotang}^2 \alpha \sin^2 \psi) \sqrt{1 - \sin^2 \varepsilon \sin^2 \psi}}$$

ω_0 and Φ_0 being the values of ω and Φ, corresponding to $\psi = 0$ or $\varphi = \frac{1}{2} \pi + \alpha$.

Transformations equally easy conduct to the expression for the arc. In fact, we obtain, by expressing $\sin^2 \varrho$, $d\omega$, $\operatorname{cotang} \varrho$ in terms of φ,

$$\sin^2 \varrho \, d\omega^2 = \frac{1}{n^2} \frac{d\varphi^2}{\frac{A^2 + B^2}{2} + \frac{A^2 - B^2}{2} \cos 2 (\varphi - \alpha)}$$

$$d\varrho = - A B \sin^2 \varrho \frac{d \varphi}{\cos^2 \varphi}$$

$$= - A B \frac{d\varphi}{\frac{A^2 + B^2}{2} + \frac{A^2 - B^2}{2} \cos 2 (\varphi - \alpha)}$$

and in consequence

$$ds = \frac{d\varphi'}{n} \frac{\sqrt{n^2 A^2 B^2 + A^2 - (A^2 - B^2) \sin^2 \varphi'}}{A^2 - (A^2 - B^2) \sin^2 \varphi'}$$

or putting $\qquad n B = \operatorname{cotang} \eta$

$$ds = \frac{d\varphi'}{n A \sin \eta} \frac{\sqrt{1 - \sin^2 \eta \sin^2 \varepsilon \sin^2 \varphi'}}{1 - \sin^2 \varepsilon \sin^2 \varphi'} .$$

If we next take

$$\sin \chi = \sin \eta \sin \varepsilon$$
$$\operatorname{cotang} \varphi' = \cos \chi \operatorname{tang} X$$

there will result

$$s = \frac{\cos^2 \chi}{n A \sin \eta \cos^2 \varepsilon} \int_0^{X} \frac{dX}{(1 + \cos^2 \eta \operatorname{tang}^2 \varepsilon \sin^2 X) \sqrt{1 - \sin^2 \chi \sin^2 X}} .$$

If the expression for the central force were to be deprived of the term multiplied by K, so that

$$F(\varrho) = - \frac{c^2 h \cos \varrho}{\sin^3 \varrho}$$

it would be necessary to make either $A = 1$ or $B = 1$. In the former case the equation of the trajectory would be

$$\operatorname{cotang} \varrho = \cos \varepsilon \frac{e^{n \omega} e^{-n \omega}}{2}$$

and in consequence of the relatives

$$\cos \alpha = \frac{A \sqrt{1 - B^2}}{\sqrt{A^2 - B^2}} , \quad \sin \alpha = \frac{\pm B \sqrt{A^2 - 1}}{\sqrt{A^2 - B^2}}$$

the equation connecting t and φ would become by making $c\, n \sin \varepsilon \cos \varepsilon = n''$

$$\sin \varphi = \operatorname{cosec} \varepsilon \, . \frac{e^{n'' t} - e^{-n'' t}}{e^{n'' t} + e^{-n'' t}}$$

that is to say,

$$\frac{e^{n \omega} - e^{-n \omega}}{e^{n \omega} + e^{-n \omega}} = \operatorname{cosec} \varepsilon \, . \frac{e^{n'' t} - e^{-n'' t}}{e^{n'' t} + e^{-n'' t}} .$$

We shall also have $\qquad A = \Omega_{(x = 0)}$.

In the second case, where $B = 1$, we shall have

$$\frac{e^{n \omega} - e^{-n \omega}}{e^{n \omega} + e^{-n \omega}} = \operatorname{cotang} \varepsilon \operatorname{tang} n''' (t + \tau)$$

or, if we choose,

$$\operatorname{Tang} n\omega = \operatorname{cotang} \varepsilon \operatorname{tang} n''' (t + \tau)$$

an expression in which $n''' = c\, n \operatorname{tang} \varepsilon$, $\tau = \varepsilon \sec \varepsilon$, and where $T g \, . \, n \, \omega$ denotes the hyperbolic tangent, that is, the exponential function immediately preceding. We have also

$$A = \Omega_{(x = \frac{1}{2} \pi)} .$$

I do not stop to discuss the mechanical peculiarities of the preceding results, but pass to the consideration of

2d. The form

$$\operatorname{cotang} \varrho = a + b \frac{e^{n \omega} + e^{-n \omega}}{2}$$

which represents a curve, symmetrical with relation to the polar axis, and the two branches of which, intersecting upon this axis at each semicircumference, finish by reaching the pole which is the origin of ϱ, or that which is diametrically opposite according to the signs of a and b, after an infinite number of circumvolutions around the one or the other of these points.

I will give a capital initial to the circular trigonometric symbols to designate the same hyperbolic functions, so that

$$\operatorname{Sin} n\omega = \tfrac{1}{2} (e^{n \omega} - e^{-n \omega}) , \quad \operatorname{Cos} n\omega = \tfrac{1}{2} (e^{n \omega} + e^{-n \omega}) , \quad \operatorname{Tang} n\omega = \frac{\operatorname{Sin} n\omega}{\operatorname{Cos} n\omega} \text{ \&c.}$$

We have the relations

$$\operatorname{Cos}^2 \tfrac{1}{2} n\omega - \operatorname{Sin}^2 \tfrac{1}{2} n\omega = 1$$
$$\operatorname{Cos}^2 \tfrac{1}{2} n\omega + \operatorname{Sin}^2 \tfrac{1}{2} n\omega = \operatorname{Cos} n\omega$$

whence,

$$\operatorname{Cos} n\omega = \frac{\operatorname{Cos}^2 \frac{1}{2} n\omega + \operatorname{Sin}^2 \frac{1}{2} n\omega}{\operatorname{Cos}^2 \frac{1}{2} n\omega - \operatorname{Sin}^2 \frac{1}{2} n\omega} = \frac{1 + \operatorname{Tang}^2 \frac{1}{2} n\omega}{1 - \operatorname{Tang}^2 \frac{1}{2} n\omega} .$$

By this latter relation, the equation of the trajectory becomes

$$\operatorname{cotang} \varrho = \frac{a + b - (a - b) \operatorname{Tang}^2 \frac{1}{2} n\omega}{1 - \operatorname{Tang}^2 \frac{1}{2} n\omega}$$

and if we put

$$a + b = \operatorname{cotang} (\alpha - \varepsilon) , \quad a - b = \operatorname{cotang} (\alpha + \varepsilon)$$

$$\operatorname{Tang} \tfrac{1}{2} n\omega = \sqrt{\frac{\sin (\alpha + \varepsilon)}{\sin (\alpha - \varepsilon)}} \operatorname{tang} \tfrac{1}{2} \varphi , \quad \operatorname{tang} \tfrac{1}{2} \varphi = z$$

we obtain

$$\operatorname{cotang} \varrho = \frac{\cos (\alpha - \varepsilon) - \cos (\alpha + \varepsilon) z^2}{\sin (\alpha - \varepsilon) - \sin (\alpha + \varepsilon) z^2}$$

whence we deduce immediately

$$\sin^2 \varrho = \frac{\{\sin (\alpha - \varepsilon) - \sin (\alpha + \varepsilon) z^2\}^2}{z^4 - 2 \cos 2 \varepsilon \, . \, z^2 + 1}$$

$$\cos^2 \varrho = \frac{\{\cos (\alpha - \varepsilon) - \cos (\alpha + \varepsilon) z^2\}^2}{z^4 - 2 \cos 2 \varepsilon \, z^2 + 1} .$$

We have then

$$\operatorname{Cos}^2 \tfrac{1}{2} n\omega = \frac{1}{1 - \operatorname{Tang}^2 \frac{1}{2} n\omega} = \frac{\sin (\alpha - \varepsilon)}{\sin (\alpha - \varepsilon) - \sin (\alpha + \varepsilon) z^2}$$

$$d \operatorname{Tang} \tfrac{1}{2} n\omega = \frac{d \frac{1}{2} n\omega}{\operatorname{Cos}^2 \frac{1}{2} n\omega} = \sqrt{\frac{\sin (\alpha + \varepsilon)}{\sin (\alpha - \varepsilon)}} \, dz$$

and therefore

$$d \tfrac{1}{2} n\omega = \sqrt{\sin (\alpha + \varepsilon) \sin (\alpha - \varepsilon)} \, . \frac{dz}{\sin (\alpha - \varepsilon) - \sin (\alpha + \varepsilon) z^2} .$$

The equation of the areas will, when we put

$$\frac{1}{n c} \sqrt{\sin (\alpha + \varepsilon) \sin (\alpha - \varepsilon)} = \frac{1}{n'}$$

furnish as the equation

$$n' \, dt = \frac{2 \left\{ \sin (\alpha - \varepsilon) - \sin (\alpha + \varepsilon) z^2 \right\}}{z^4 - 2 \cos 2 \varepsilon \, . \, z^2 + 1} \, d z$$

and if we observe that

$$z^4 - 2 \cos 2 \varepsilon \, . \, z^2 + 1 = (z^2 + 1)^2 - 2 \, (1 + \cos 2 \varepsilon) \, z^2 = (z^2 + 1)^2 - 4 \cos^2 \varepsilon \, z^2$$

that is

$$(z^2 + 2 \cos \varepsilon \, . \, z + 1) \, (z^2 - 2 \cos \varepsilon \, . \, z + 1)$$

we may write

$$n' \, dt = \frac{\sin \alpha \, (z + \cos \varepsilon) - \cos \alpha \sin \varepsilon}{z^2 + 2 \cos \varepsilon \, . \, z + 1} \, d z - \frac{\sin \alpha \, (z - \cos \varepsilon) - \cos \alpha \sin \varepsilon}{z^2 - 2 \cos \varepsilon \, . \, z + 1} \, d z.$$

From this, remarking that the first part, for example, may be decomposed into the two others,

$$\tfrac{1}{2} \sin \alpha \, \frac{d \, . \, (z^2 + 2 \cos \varepsilon \, . \, z + 1)}{z^2 + 2 \cos \varepsilon \, . \, z + 1} \text{ and } - \cos \alpha \, \frac{d \, \dfrac{z + \cos \varepsilon}{\sin \varepsilon}}{1 + \left(\dfrac{z + \cos \varepsilon}{\sin \varepsilon} \right)^2}$$

integrating and adding the two arcs introduced,

$$n' t = \tfrac{1}{2} \sin \alpha \; l \, \frac{z^2 + 2 \cos \varepsilon \, . \, z + 1}{z^2 - 2 \cos \varepsilon \, . \, z + 1} - \cos \alpha \text{ arc} \left[\text{tang} = \frac{2 \sin \varepsilon \, . \, z}{1 - z^2} \right]$$

in which the variable z, and therefore φ and ω, are to be made to commence with t. Substituting the value of z in terms of φ, we shall have this other form,

$$n' t = \tfrac{1}{2} \sin \alpha \; l \, \frac{1 + \cos \varepsilon \sin \varphi}{1 - \cos \varepsilon \sin \varphi} - \cos \alpha \text{ arc} \, [\text{tang} = \sin \varepsilon \text{ tang } \varphi] \, .$$

If in this expression we make $\varphi = \frac{1}{2} \pi$, we shall have the time employed by the body for reaching the point determined by

$$e^{2nv} = \frac{1 + \sqrt{\dfrac{\sin (\alpha + \varepsilon)}{\sin (\alpha - \varepsilon)}}}{1 - \sqrt{\dfrac{\sin (\alpha + \varepsilon)}{\sin (\alpha - \varepsilon)}}}, \quad \text{cotang } \varrho = - \text{ tang } \alpha.$$

To know the spherical area limited by the arc and two radius-vectors, it must be observed that according to the preceding expressions of $\cos \varrho$ and $d\omega$ we have,

$$\frac{n}{2} \cos \varrho \, d\omega = \sqrt{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)} \, . \, \frac{\cos (\alpha - \varepsilon) - \cos (\alpha + \varepsilon) \, z^2}{\sin (\alpha - \varepsilon) - \sin (\alpha + \varepsilon) \, z^2} \, \frac{dz}{\sqrt{z^4 - 2 \cos 2 \varepsilon \, z^2 + 1}}$$

or

$$\frac{n}{2} \cos \varrho \, d\omega = \sqrt{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)} \, . \, \frac{\sin \alpha \sin \varepsilon + \cos \alpha \cos \varepsilon \cos \phi}{- \cos \alpha \sin \varepsilon + \sin \alpha \cos \varepsilon \cos \phi} \, \frac{d\varphi}{\sqrt{1 - \cos^2 \varepsilon \sin^2 \varphi}}$$

an equation which, if we multiply both the numerator and denominator of the second member by $\cos \alpha \sin \varepsilon + \sin \alpha \cos \varepsilon \cos \phi$, may also be written,

$$\frac{n}{2} \cos \varrho \, d\omega = \frac{\sqrt{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)} \sin \varepsilon \cos \varepsilon \cos \phi \, d\varphi}{\left\{ \sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon) - \sin^2 \alpha \cos^2 \varepsilon \sin^2 \varphi \right\} \sqrt{1 - \cos^2 \varepsilon \sin^2 \varphi}}$$
$$+ \frac{\sqrt{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)} \sin \alpha \cos \alpha \sqrt{1 - \cos^2 \varepsilon \sin^2 \varphi} \, d\varphi}{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon) - \sin^2 \alpha \cos^2 \varepsilon \sin^2 \varphi} .$$

The first part, by putting $\cos \varepsilon \sin \varphi = \sin \varpi$, becomes

$$\sqrt{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)} \, \frac{d \sin \varepsilon \text{ tang } \varpi}{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon) - \sin^2 \varepsilon \text{ tang}^2 \varpi}$$

and gives by integration, observing that all the preceding calculations assume in fact $\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon) > 0$

$$\tfrac{1}{2} \, l \, . \, \frac{\sqrt{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)} + \sin \varepsilon \text{ tang } \varpi}{\sqrt{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)} - \sin \varepsilon \text{ tang } \varpi} = \tfrac{1}{2} \, \Phi.$$

The second part may be reduced, by the substitution cotang $\varphi = \sin \varepsilon \text{ tang } \psi$, to

$$\frac{\sqrt{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)} \sin \alpha \cos \alpha \, d\psi}{(\cos^2 \alpha - \cos^2 \varepsilon \sin^2 \psi) \sqrt{1 - \cos^2 \varepsilon \sin^2 \psi}}$$

and these two partial results give for the area A, vanishing with ψ,

$$A = \omega - \omega_0 + \frac{\Phi_0 - \Phi}{n} - \frac{\sin 2\alpha \sqrt{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)}}{n} \int_0^{\psi} \frac{d\psi}{(\cos^2 \alpha - \cos^2 \varepsilon \sin^2 \psi) \sqrt{1 - \cos^2 \varepsilon \sin^2 \psi}}$$

in which Φ_0 is the value of Φ for $\psi = 0$, or for $\sin \varpi = \cos \varepsilon$, and in which ω_0 is determined by the relation

$$\text{Tang } \tfrac{1}{2} \, n\omega_0 = \sqrt{\frac{\sin (\alpha + \varepsilon)}{\sin (\alpha - \varepsilon)}} \, ,$$

which gives

$$\text{Cos } n\omega_0 = \frac{\sin (\alpha - \varepsilon) + \sin (\alpha + \varepsilon)}{\sin (\alpha - \varepsilon) - \sin (\alpha + \varepsilon)} = - \text{ tang } \alpha \text{ cotang } \varepsilon \, ,$$

which requires that the product tang α cotang ε should be negative. The corresponding value of ϱ is given by

$$\text{cotang } \varrho_0 = - \text{ tang } \alpha.$$

If it be desired to pass to the determination of the arc, from the expressions of cotang ϱ, $\sin^2 \varrho$, $d\omega$ in z may be deduced the equations

$$d\varrho = \frac{- 2 \sin 2 \varepsilon \, . \, z \, dz}{z^4 - 2 \cos 2 \varepsilon \, z^2 + 1}$$

$$\sin^2 \varrho \, d\omega^2 = \frac{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)}{n^2} \, \frac{4 \, dz^2}{z^4 - 2 \cos 2 \varepsilon \, . \, z^2 + 1}$$

or $$d\varrho = \frac{-\sin\varepsilon\cos\varepsilon\sin\varphi\,d\varphi}{1-\cos^2\varepsilon\sin^2\varphi}$$

$$\sin^2\varrho\,d\omega^2 = \frac{\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon)}{n^2}\,\frac{d\varphi^2}{1-\cos^2\varepsilon\sin^2\varphi}$$

whence by making

$$\cos^2\varepsilon\left(1-\frac{n^2\sin^2\varepsilon}{\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon)}\right)=\pm\operatorname{tang}^2\gamma$$

according as $(n^2+1)\sin^2\varepsilon \lessgtr \sin^2\alpha$

$$ds = \frac{\sqrt{\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon)}}{n}\cdot\frac{\sqrt{1\pm\operatorname{tang}^2\gamma\sin^2\varphi}}{1-\cos^2\varepsilon\sin^2\varphi}\,d\varphi.$$

With the sign $+$, the substitution $\operatorname{tang}\phi = \cos\gamma\operatorname{tang}\psi$ will give,

$$s = \frac{\sqrt{\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon)}\,.\cos\gamma}{n}\int_0^{\psi}\frac{d\psi}{(1-\sin^2 K\sin^2\psi)\sqrt{1-\sin^2\gamma\sin^2\psi}}$$

in which $\sin\varepsilon\cos\gamma = \cos K$. The origin of the arc will have for co-ordinates $\omega = 0$, $\varrho = \alpha-\varepsilon$.

With the sign $-$, supposing at first, $\operatorname{tang}^2\gamma < 1$, by assuming

$$\operatorname{tang}\gamma = \sin\eta \qquad \operatorname{cotang}\varphi = \cos\eta\operatorname{tang}\psi$$

we shall obtain,

$$s = \frac{\sqrt{\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon)}}{n}\,\frac{\cos^2\eta}{\cos^2\varepsilon}\int_0^{\psi}\frac{d\psi}{\left(1+\frac{\cos^2\eta}{\cos^2\varepsilon}\sin^2\psi\right)\sqrt{1-\sin^2\eta\sin^2\psi}},$$

the origin of the arc $(\omega_0\;\varrho_0)$ being determined by the equations

$$\operatorname{Cos} n\,\omega_0 = -\operatorname{tang}\alpha\operatorname{cotang}\varepsilon$$
$$\operatorname{cotang}\varrho_0 = -\operatorname{tang}\alpha.$$

If we had $\operatorname{tang}^2\gamma > 1$, I do not perceive any simple transformation capable of reducing the expression or the arc to a single elliptic transcendent. But it resolves itself naturally into one of the first, and one of the third order, by multiplying the two terms of dt by the radical, and then diminishing the modulus by a unit, by means of the ordinary substitution

$$\operatorname{tang}\gamma\sin\phi = \sin\psi.$$

All that precedes supposes in fact that $\sin^2\alpha - \sin^2\varepsilon > 0$. Since the relative magnitudes of the primitive coefficients a and b might occasion the contrary result, it would in this case only be necessary to put

$$\operatorname{Tang}\tfrac{1}{2}n\omega = \sqrt{\frac{\sin(\alpha+\varepsilon)}{\sin(\varepsilon-\alpha)}}\,.\operatorname{tang}\tfrac{1}{2}\varphi\,;\quad \operatorname{tang}\tfrac{1}{2}\varphi = z$$

and to make precisely the same transformations afterwards. So that if I have not included these two cases in one and the same type, it is solely for the sake of avoiding in the notation the presence of the ambiguous symbols $\pm$ and $\frac{\sin}{\cos}$. We shall thus find,

$$n't = \tfrac{1}{2}\cos\alpha\; l\,.\,\frac{1+\sin\varepsilon\sin\varphi}{1-\sin\varepsilon\sin\varphi} - \sin\alpha\;\text{arc}\;[\operatorname{tang} = \cos\varepsilon\operatorname{tang}\phi]$$

in which

$$n' = \frac{c\,n}{\sqrt{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}}$$

$$A = \omega + \frac{1}{2n}\,l\,.\,\frac{\sqrt{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}+\cos\varepsilon\operatorname{tang}\varpi}{\sqrt{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}-\cos\varepsilon\operatorname{tang}\varpi} - \int_0^{\psi}\frac{\sqrt{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}\operatorname{cotang}\alpha\,.\,d\psi}{\left(1-\frac{\sin^2\varepsilon}{\sin^2\alpha}\sin^2\psi\right)\sqrt{1-\sin^2\varepsilon\sin^2\psi}}$$

where $\sin\varpi = \sin\varepsilon\sin\varphi$, $\operatorname{cotang}\psi = \cos\varepsilon\operatorname{tang}\varphi$

$$s = \frac{\sqrt{\sin(\varepsilon-a)\sin(\varepsilon+\alpha)}}{n}\int_0^{\phi}\frac{\sqrt{1\pm\operatorname{tang}^2\gamma\sin^2\varphi}}{1-\sin^2\varepsilon\sin^2\varphi}\,d\varphi$$

an expression in which

$$\sin^2\varepsilon\left(1-\frac{n^2\cos^2\varepsilon}{\sin^2\varepsilon-\sin^2\alpha}\right)=\mp\operatorname{tang}^2\gamma,$$

and which reduces itself immediately to one function of the third class, except perhaps in the case where with the inferior sign for the radical we have $\operatorname{tang}^2\gamma > 1$, and it is necessary to mention that in the function of the third class I suppose any parameter whatever, and consequently not reduced in all cases to the logarithmic or circular form, a reduction which would introduce the function of the first class.

5′. I will not dwell upon the particular cases resulting from the equality to zero of either of the coefficients K or h which enter into the expression for $F(\varrho)$, but will pass to the equation (g), which after the polar axis has been made to rotate about the angle ω_0 and $\frac{K}{n^2}$ and A' have been replaced by a and b respectively, becomes,

$$\operatorname{cotang}\varrho = a + b\cos n\omega$$

in which we may suppose a and b positive, except where the first member is taken as negative. According to this, α and ε denoting two positive arcs less than $\frac{1}{2}\pi$ it is allowable to make

$$a+b = \operatorname{cotang}(\alpha-\varepsilon)$$
$$a-b = \operatorname{cotang}(\alpha+\varepsilon).$$

Suppose at first $a > b$, which makes

$$\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon) > 0$$

I will take

$$\operatorname{tang}\tfrac{1}{2}n\omega = \sqrt{\frac{\sin(\alpha+\varepsilon)}{\sin(\alpha-\varepsilon)}}\operatorname{tang}\tfrac{1}{2}\phi\,;\quad \operatorname{tang}\tfrac{1}{2}\varphi = z\,;$$

then, since

$$\cos n\omega = \frac{1-\operatorname{tang}^2\frac{1}{2}n\omega}{1+\operatorname{tang}^2\frac{1}{2}n\omega}$$

the equation of the trajectory will become

$$\operatorname{cotang}\varrho = \frac{\cos(\alpha-\varepsilon)+\cos(\alpha+\varepsilon)z^2}{\sin(\alpha-\varepsilon)+\sin(\alpha+\varepsilon)z^2}.$$

From this we deduce

$$\sin^2\varrho = \frac{\{\sin(\alpha-\varepsilon)+\sin(\alpha+\varepsilon)z^2\}^2}{z^4+2\cos 2\varepsilon\,z^2+1}.$$

(*To be continued.*)

OBSERVATIONS OF COMET 1854, IV., PROSERPINA, EGERIA, EUPHROSYNE, POLYMNIA, POMONA, AND THETIS.

By PROFESSOR CHARLES RÜMKER.

COMET 1854, IV.

1854.	Hamburg M. T.	☄ α	Log. Fact. Parall.	☄ δ	Log. Fact. Parall.	No. of Comp.	Apparent Places of Comparison-Stars.	
							α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
Sept. 15	8 39 4.4	133 48 22.9		+73 0 27.4		6	8 55 13.645 8 55 13.409	+72 53 0.9 73 0 27.3
17	7 49 25.4	141 35 42.6		71 9 22.4		2	9 30 59.241	71 5 32.5
19	8 27 28.0	148 4 53.0		69 0 21.9		5	9 57 5.545	69 8 58.9
21	8 11 19.0	153 18 5.4		66 41 58.9		5	10 14 29.971	66 38 39.7
23	8 2 29.3	157 31 24.8		64 17 46.3		2	10 25 55.587	64 20 34.8
25	8 5 16.0	161 2 40.8		61 48 35.9		3	10 43 38.607	61 51 53.8
27	7 37 49.1	163 56 49.4		59 18 50.4		8	10 53 22.581	59 26 51.6
28	7 39 18.5	165 14 20.3		58 2 49.2		7	10 57 56.115 11 0 24.839	57 50 14.4 58 24 19.6
29	7 51 44.1	166 27 7.4		56 45 46.0		4	11 19 46.294	56 41 43.1
Oct. 7	7 36 58.1	173 30 8.0	9.7748	46 42 46.8	9.9380	6	11 37 47.944	46 24 40.0
8	7 5 13.9	174 9 21.9	9.8194	45 30 46.3	9.9198	6	11 36 34.6 11 41 43.319	45 17 49.5 45 33 0.6
9	7 8 59.6	174 47 28.4	9.8019	44 16 51.9	9.9268	3	11 34 49.440	44 35 53.2
13	7 8 0.8	177 3 35.4	9.7596	39 26 55.5	9.9410	6	11 47 47.324	39 34 6.8
14	6 56 7.2	175 54 15.1	9.7584	38 20 14.8	9.9408	2	11 44 33.711	38 25 48.5
18	6 33 18.5	179 26 53.8	9.7647	+33 34 16.8	9.9351	6	11 57 23.492	+33 39 48.8

PROSERPINA.

1854.	Hamburg M. T.	㉖ α	㉖ δ	No. of Comp.	Apparent Places of Comparison-Stars.	
					α	δ
	h. m. s.	° ′ ″	° ′ ″		h. m. s.	° ′ ″
Sept. 12	9 8 5.0	340 40 6.1	—13 41 32.4	6	22 44 9.438	—13 52 11.9
15	10 16 16.0	340 2 21.7	13 51 59.0 :	1		
19	9 47 10.6	339 17 14.7	14 3 38.6 :	1	22 41 54.106	14 21 29.7
21	9 31 16.2	338 55 45.4	14 8 26.0	6	22 38 31.194	14 17 23.6
27	8 47 55.5	337 57 39.8	—14 20 58.6	6	22 32 23.825	—14 22 55.4

EGERIA.

1854.	Hamburg M. T.	⑬ α	Log. Fact. Parall.	⑬ δ	Log. Fact. Parall.	No. of Comp.	Apparent Places of Comparison-Stars.	
							α	δ
	h. m. s.	° ″ ″		° ′ ″			h. m. s.	° ′ ″
Oct. 24	9 27 32.3	17 21 47.8	n9.3605	—3 44 40.0	9.9226	11	1 9 16.862	—3 27 14.9
26	7 59 8.1	16 52 36.6	n9.6043	3 41 20.5	9.9186	9	1 9 16.867	3 27 15.0
27	8 1 34.4	16 37 42.5	n9.5884	3 39 24.2	9.9189	10	1 5 59.590	3 19 12.8
28	7 21 45.3	16 23 39.1	n9.6556	—3 37 30.5	9.9168	15	1 5 59.591	—3 19 12.9

EUPHROSYNE.

1854.	Hamburg M. T.	㉛ α	Log. Fact. Parall.	㉛ δ	Log. Fact. Parall.	No. of Comp.	Apparent Places of Comparison-Stars	
							α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
Oct. 1	9 21 18.3	22 57 26.7		—2 31 46.5		10	1 30 49.695	—2 29 45.9
14	8 14 58.0	19 31 1.4	n9.6770	2 9 47.1	9.9116	2	1 13 29.324	2 4 22.3
	9 45 54.8	19 29 59.2	n9.4616	2 9 39.4	9.9146	7		
18	7 43 51.9	18 25 29.3	n9.6921	1 59 58.3	9.9105	19	1 13 29.347	2 4 22.7
21	7 48 53.5	17 36 12.0	n9.6633	1 51 7.9	9.9108	10	1 7 24.895	1 45 5.9
24	8 44 42.6	16 47 20.1	n9.5087	1 41 23.9	9.9122	14	1 7 24.908	1 45 6.0
26	6 57 24.6	16 17 5.6	n9.7012	1 34 40.0	9.9091	11	1 7 24.917	1 45 6.0
27	7 9 5.1	16 1 24.3	n9.6781	1 30 50.8	9.9094	13	1 2 22.676	1 30 32.2
28	8 24 38.1	15 45 14.9	n9.5094	1 26 54.1	9.9111	17	1 2 22.677	1 30 32.2
29	7 30 58.2	15 30 45.0	n9.6254	—1 23 12.3	9.9098	18	1 2 22.678	—1 30 32.3

POLYMNIA.

1854.	Hamburg M. T.	㉝ α	Log. Fact. Parall.	㉝ δ	Log. Fact. Parall.	No. of Comp.	Apparent Places of Comparison-Stars.	
							α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
Nov. 9	7 57 41.8	35 49 33.8	*n*9.6638	+16 18 28.0	9.8180	2	2 23 35.278	+16 22 17.6
11	7 34 23.8	35 24 43.6	*n*9.6851	16 11 36.7	9.8242	8	2 19 32.820	15 59 30.2
12	8 45 21.9	35 11 57.3	*n*9.5214	16 7 57.4	9.7998	4		
13	6 46 52.5	35 1 0.8	*n*9.7339	16 4 59.3	9.8392	12		
14	7 51 9.4	34 48 53.7	*n*9.6305	16 1 35.2	9.8140	6		
17	9 11 13.3	34 15 32.3	*n*9.3229	+15 51 52.1	9.7913	5	2 19 32.850	+15 59 30.4

POMONA.

1854.	Hamburg M. T.	㉜ α	Log. Fact. Parall.	㉜ δ	Log. Fact. Parall.	No. of Comp.	Apparent Places of Comparison-Stars.	
							α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
Nov. 11	6 41 25.1	33 6 27.9	*n*9.7315	+13 25 22.4	9.8549	16	2 10 41.928 2 12 20.507	+13 16 47.7 13 37 47.5
12	7 56 58.8	32 53 31.5	*n*9.6136	13 18 27.6 :	9.8319	12	2 10 41.927	13 16 47.9
13	7 38 51.2	32 41 43.7	*n*9.6400	13 12 48.3	9.8360	18	2 10 41.932	13 16 47.8
14	7 7 52.6	32 30 29.9	*n*9.6838	13 6 58.9	9.8395	11	2 10 41.935	13 16 47.8
17	8 8 6.2	31 55 32.4	*n*9.5272	+12 49 8.5	9.8273	13	2 10 15.622	+12 45 30.8

THETIS.

1854.	Hamburg M. T.	⑰ α	Log. Fact. Parall.	⑰ δ	Log. Fact. Parall.	No. of Comp.	Apparent Places of Comparison-Stars.	
							α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
Nov. 11	9 48 54.1	95 54 15.6	*n*9.7824	17 54 59.9	9.8550	12	6 23 49.47 6 23 50.16	+17 52 44.1 +17 53 1.6

OBSERVATIONS OF URANIA,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

BY JAMES FERGUSON.

[Communicated by Lieutenant MAURY. — Corrected for refraction.]

Date.	Washington M. T.	No. of Comp.	Comparison-Star.	㉚ — ∗		㉚'s apparent	
				Δ α	Δ δ	α	δ
1854.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Oct. 19	8 22 52.3	10	Argel. Zones 249, 89	+0 7.69	+ 0 2.89	20 43 3.37	—16 57 0.16
20	7 34 0.1	10	" 249, 89	+1 1.15	+ 3 48.96	20 43 56.81	16 54 14.15
21	7 16 28.0	7	" 249, 89	+1 57.20	+ 7 41.45	20 41 52.84	16 49 22.71
22	7 18 50.5	6	" 249, 89	+2 55.34	+11 50.08	20 45 50.97	16 45 13.12
"	7 22 7.9	5	" 249, 92	—1 9.98	— 4 39.84	20 45 50.45	16 45 16.35
23	7 32 24.8	14	" 249, 92	—0 9.66	— 0 25.86	20 46 50.86	16 41 2.04
24	7 13 25.9	10	" 249, 92	+0 50.13	+ 3 49.42	20 47 50.64	16 36 46.82
"	7 22 6.2	5	" 249, 97	—1 40.65	— 1 36.18	20 47 51.19	16 36 45.08
25	7 21 55.3	10	" 249, 97	—0 38.44	+ 2 47.47	20 48 53.39	16 32 21.48
30	7 22 31.7	10	" 249, 104	—2 2.98	+ 3 35.17	20 54 22.47	16 9 2.62
31	7 45 0.6	10	" 249, 104	—0 52.80	+ 8 43.41	20 55 32.64	16 3 54.42
Nov. 2	7 26 45.2	10	" 249, 108	—0 48.81	+15 33.15	20 57 53.98	15 53 37.08
5	7 27 36.7	13	" 249, 111	+1 13.14	— 8 0.59	21 1 35.47	—15 37 17.70

Adopted Mean Places for 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Argel. Zones 249, 89	(8.9)	20 42 40.07	—16 58 13.94	Argelander's Zones.
" 249, 92	(9)	20 46 45.03	16 41 41.40	
" 249, 97	(5)	20 49 16.36	16 36 20.01	
" 249, 104	(8.9)	20 56 10.07	16 13 37.75	
" 249, 108	(8)	20 58 27.49	16 10 10.90	
" 249, 111	(8.9)	21 0 7.12	—15 30 18.30	

ELEMENTS OF EUPHROSYNE.

By JAMES FERGUSON.

The following elements are computed from Washington observations of September 2, 6, 10, 29, and 30; October 5, 7, 30, and 31; November 2, 4, and 5; giving the three following normal places referred to the mean equinox of 1856.0.

M. T. Berlin.	α	δ
	h. m. s.	° ′ ″
Sept. 5.0	1 51 21.79	—2 54 48.11
Oct. 5.0	1 28 11.00	2 26 54.78
Nov. 4.0	0 56 39.88	—0 57 56.13

M	300° 57′ 52″.62	1854, Sept. 14.0, M. T. Berlin.
π	94 0 37.73	Mean equinox, 1856.0.
☊	31 24 24.21	
i	26 28 21.3	
φ	12 31 23.7	
Log μ	2.8008456	
" a	0.4994407	

	Calc. — Obs. $\Delta\alpha$	Calc. — Obs. $\Delta\delta$
	s.	″
Sept. 14	+1.33	+46.00
Dec. 21	—0.75	+28.29

NEW WORKS.

Positions Moyennes pour l'Epoque de 1790.0 *des Etoiles circompolaires dont les Observations ont été publiées par Jérôme Lalande dans les Mémoires de l'Académie de Paris de* 1789 *et* 1790; *par* IVAN FEDORENKO, *Astronome surnuméraire à l'Observatoire de Poulkowa. Publié par Ordre de l'Académie Imperiale des Sciences.* St. Petersburg. 1851.

THE reduction of LALANDE's first zone-observations, published by him in the Paris Memoirs, was especially important for modern astronomy, inasmuch as these zones comprise a region, between the pole and 45° N. Decl., where we possess comparatively few well-determined points for comparison with wandering bodies; — and where, with the exception of GROOMBRIDGE's invaluable Catalogue, we are to a great extent almost entirely dependent upon ARGELANDER's Northern Zones, without earlier or later observations for detection of proper motion, &c. These observations of LALANDE, about 5,000 in number, are not included in the catalogue deduced from the *Histoire Céleste* by direction of the British Association, which gives only those stars for which the reduction-tables had been previously computed by HANSEN and NISSEN, and published in SCHUMACHER's Tables.

It is to STRUVE and the astronomers of Pulkowa that we are in great measure indebted for the elements which now permit the computation of similar and accurate tables, adapted to so high declinations; and in the present reductions and the able discussion prefixed to the Catalogue, we find indications of skill and accuracy betokening a worthy pupil of the great master. The comparison of this work with the reductions published by the British Association furnishes a new proof of the earnest and successful labors in Russia for the advancement of astronomy.

The introduction contains the method used in reducing the zone observations to the mean epoch of 1790.0, together with a discussion of the errors of observation and the degree of precision to be attributed to the catalogue-places. Bessel's method was used for the reductions, auxiliary tables being formed for each zone, and the constants deduced from stars which had also been determined by Argelander or Groombridge. In some instances, indeed, — where the comparison-stars were contained in the *Fundamenta Astronomiæ*, — account was taken of the proper motion of the star. For stars north of 80°, and therefore beyond the limits of Argelander's Zones, it was necessary to rely upon Groombridge's Catalogue alone; and a thorough investigation is consequently made into the precision of the absolute positions given in this Catalogue. Mr. Fedorenko arrives at the result, that the places given by Groombridge should be corrected

$$\text{in } \alpha \text{ by } +2''.31 \quad +1''.77 \text{ tang } \delta$$
$$\text{in } \delta \text{ by } +0.65$$

in order to obtain a maximum accordance with the observations of Argelander. These corrections having been duly applied, the present Catalogue rests entirely upon the fundamental positions of the last-mentioned astronomer. The auxiliary tables, together with the manner of their construction, are given in detail, — preliminary tables having been formed for *independent* values; i. e. those deduced from the observations of Lalande alone, without the aid of comparison-stars. The great labor requisite for these reductions must of course have been proportionate to the high declination of the stars.

Two different methods were employed for estimating the accuracy of the positions given; — the resulting probable errors are respectively,

$$\text{in } \alpha \quad 1''.47 \text{ and } 1''.78$$
$$\text{in } \delta \quad 1.99 \text{ and } 1.92$$

thus confirming the bold assertion of Lalande, that his error in the circle-readings could not exceed 2′ although the vernier-readings were only to the nearest quarter of a minute.

The number of stars catalogued by Mr. Fedorenko is 4,673, derived from 52 zones, — a proportion nearly the same as in Baily's Catalogue, which contains 47,390 positions, from 532 zones.

A valuable supplement, not indicated in the title-page, contains a catalogue deduced from thirteen northern zones of the *Histoire Céleste* omitted in the British Association reductions, and from two other small zones in the Paris memoirs. This supplementary catalogue contains 339 stars.

G.

ERRATA IN ZECH'S TABLES.

The following errata in Zech's Addition and Subtraction Tables have been communicated by Mr. E. B. Elliott of Boston.

On page 806, and in a line with argument 0.1482,

for	9164	8918	8672	8426	8181	7935	7689
read	9064	8818	8572	8326	8081	7835	7589

CORRIGENDA.

In Index to Vol III., page 193, for *Amphitrite* 27th, read *Amphitrite* 29th.
Vol. IV. page 19, column 2, line —1, *for* twelve, *read* eleven.
" " 30, " 2, " 22, " clear, " clean.
" " 40, " 1, " 17, " time, " line.

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Problems of Spherical Mechanics, by Mr. Edward Combescure.
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Observations of Urania, made with the Filar-Micrometer of the Washington Equatorial, by James Ferguson, Esq.
Elements of Euphrosyne, by James Ferguson, Esq.
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ON THE VARIABLE STAR *ALGOL*,

OR *β Persei.*

ALGOL, or *β Persei*, unquestionably belongs to the most remarkable of all the variable stars, on account of the shortness of its period, in general, and especially of the short time during which it continues at its minimum, on account of the comparative precision with which this minimum may be determined, and the regularity with which the star goes through its period. This regularity is so great that WURM, even in the year 1819, that is to say, thirty-six years after GOODRICKE had discovered the periodicity of the variation of light in *Algol*, was able to represent all the observations by a uniform period, and did not venture to decide whether this period had become longer or shorter.* Nevertheless, the values of the duration of a period computed by himself at various epochs, indicate the former of these alternatives. From the earlier observations, comprising a series of 16 months, he found the period to be $2^{d.}\,20^{h.}\,48^{m.}\,59^{s.}$; after 16 years of additional observations, he diminished the time by $0^{s.}.3$, and redetermined it after 36 years as $2^{d.}\,20^{h.}\,48^{m.}\,58^{s.}.5$. The diminution of the time indicated by these computations has been put beyond all doubt by modern observations, which have also shown that the amount of this diminution is not proportional to the time, but is continually growing larger and larger. A collation of the duration of the period, as obtained by combining the nearly contemporaneous observations, and discussing these series according to the method of least squares, will show this very distinctly. If we assume as the principal epoch that of the minimum, which occurred 1800, January 2, morning, Paris civil time, the first column of the following small table gives the number of periods completed since this principal epoch; the second, the time; the third, the duration of the period which holds for this time; and the fourth, the probable uncertainty of this latter determination.

PERIODS OF *ALGOL*.

No. of Period.	Date.	Length of Period.	
		d. h. m. s.	s.
—1987	1784, May 27	2 20 48 59.42	±0.32
—1405	1788, Dec. 21	58.74	±0.09
— 825	1793, July 11	58.39	±0.18
+ 751	1805, Nov. 25	58.45	±0.04
+2328	1818, Apr. 13	58.19	±0.10
+3885	1830, July 3	57.97	±0.05
+5441	1842, Sept. 20	55.18	±0.35
+6183	1848, July 18	53.37	±0.08

A glance at this table shows immediately that the several observations can be represented neither by a uniform nor by a uniformly diminishing length of period. This would, however, be obtained by having regard to the third and fourth power of the time; or, still better, by introducing a correction to a uniform period, which should progress according to sines and cosines in such a way that the p^{th} minimum after the epoch E would be given by the formula,

$$E + ap + b \sin (np + B) + c \sin (2np + C) + \ldots..$$

But the endeavor to develop the constants, even taking account merely of the first term in the series of sines, proves fruitless, owing to the insufficiency of the data; of which, indeed, we have a tolerable number for the last century, but which since then are so scarce, that for the first forty years of the present century I am only aware of 19 observed minima. In the last few years the attention of astronomers has certainly been again more directed to this remarkable phenomenon; but if we are soon to arrive at an accurate knowledge of the phenomenon itself, and of the rules according to which the period varies, the number of observers must be very considerably increased. Out of the 127 to 128 minima which occur in a year, there are scarcely 40 for which the requisite darkness, and a sufficient altitude of the star above the horizon, permit a trustworthy observation. Then deducting, not only the many days which are overcast, but those also on which flying clouds or mist disturb the observation, as well as those on which other pressing avecations prevent the astronomer from devoting his attention to the phenomenon, this number will be extraordinarily diminished. I have myself not yet succeeded in observing more than 8 minima in any one year, and then only in the year 1840, in which no more extended series of observations demanded my time. Under these circumstances, I take the liberty of earnestly entreating American astronomers to give their attention to this interesting phenomenon. Certainly some sacrifices are requisite for this, inasmuch as a complete observation demands not less than an hour and a half, during which this star must be compared with others every $6^{m.}$ or $8^{m.}$ as regards its brilliancy. For comparison-stars I use δ and ϱ *Persei*, and α and β *Trianguli*. The star ϱ *Persei* is indeed itself somewhat variable, but its period is longer, and it is especially favorable on account of its proximity to *Algol*, and because it is very nearly equal to this star when at its minimum. In a comparison of *Algol* with ϱ, the little variations from uniformity in the transparency of the air, which always exist to a greater or less degree, will exert the smallest possible influence.

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* BODE's *Astronomisches Jahrbuch für* 1822, p. 120.

Concerning the manner in which the comparative brilliancy of stars is to be observed without the aid of instruments, I have spoken in detail in another place;[*] and will here only briefly repeat what I have there said. When the weather is misty, when clouds are flying, in bright twilight or too close vicinity to the moon, such observations should not be undertaken. It is especially important to avoid the impression of any other light, and, when the moon is up, to place one's self in such a position that the moon will be hid by some object. Before observing, the eye should be for some time accustomed to the darkness, in order that the pupil may be dilated as much as possible. Then look *alternately* at the two stars which are to be compared, and endeavor to receive the image on that part of the eye in which it is seen the brightest. On the other hand, exercise the most zealous care not to look at both stars at once, for in such case the two can never be seen at once in their full brightness. After the eye has thus been several times directed alternately to the one and to the other, and a distinct judgment formed as to their relative brilliancy, write this down in figures. I denote a decided difference in the brightness of two stars by the expression "a grade"; set down the difference of brightness as 2 grades when I can imagine a third between them, and of a brilliancy decidedly different from either; as 3, when the difference is so great that two others can be thus interpolated in imagination between them; and so on. A greater difference than 4 grades I do not estimate, since this mode then becomes too unsafe; but, on the other hand, do estimate half, and in some cases even quarter grades. In recording, the letter denoting the brighter star is first written down, then the number of grades, and last the letter of the fainter star. The precision which may be obtained in this way, after a little practice, is very considerable; the probable uncertainty amounts, for a single estimate, to about half a step, and this is much diminished by comparing the star which is to be determined with many others, especially when some of these are brighter and others fainter.

As to the computation of the time of the minimum of *Algol* from the observations at hand, I do not content myself with putting for this the time of least brilliancy; but use for this purpose all the observations made for half an hour before and after the minimum, by taking the mean of the times at which *Algol* manifested the same difference of brightness from the comparison-stars during its decrease and increase of brilliancy, and then the mean of all these means, as the final result. Treated in this way, the observations afford remarkable precision, so that the probable error of an observed minimum does not amount to so much as 6 minutes, and discordances of a quarter of an hour from the mean are extremely rare.

Since the number of observers has increased within a short time, a series of minima are available which have been independently determined by different observers, and, in part, at different places; thus affording a means of learning the real errors of observation. Since the autumn of last year I have collected 8 minima, which have been determined by several observers, the number of several observations amounting to 33. From these 33 observations the probable uncertainty in the determination of a minimum by a single observer is deduced as $5^{m}.625$. But during the same time there were, besides these, 9 other minima obtained from a single observer. These observations, 42 in all, I have, in order to be more independent of the length of the period, combined in two means, compared the several observations *singly* with these, and thus found the probable error of such an observation to be $5^{m}.895$. This error is somewhat larger than the preceding; still the difference lies considerably within the limits of uncertainty of both determinations, and consequently cannot warrant us in inferring that the period is subject to irregular variations, but merely that, if such exist, they can only be extremely small. The assumption of such an irregularity, amounting to but little more than 1^{m}, would bring the two numbers into perfect agreement.

To make the agreement in the several results more clear, I will here give the 24 minima observed during this autumn and winter, after reducing them by assuming the period $2^{d.}\,20^{h.}\,48^{m}\,53^{s}$, to one principal epoch, namely, the minimum of Oct. 8. The annexed table contains in the first column the number of periods elapsed since 1800, Jan. 2; — the second, the time as observed, reduced to mean Paris time by applying the difference of longitude; — the third indicates the observer; B. denoting Mr. **Bruhns** in Berlin; H., Prof. **Heis** in Münster; N., Dr. **Nell** in Manheim; O., Dr. **Oudemans** in Leyden; Sd., K., and A., Dr. **Schönfield**, Dr. **Krüger**, and the undersigned in Bonn. The fourth column contains the equation of light, and is that quantity which is to be added to the observed moment in order to correct it for the difference of time which, in the different distances of the stars from the earth, is required for the light to reach us. Finally, the fifth column gives the time, reduced to the principal epoch.

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[*] Schumacher's *Jahrbuch fur* 1844. p. 191 et ff.

MINIMA OF *ALGOL*.

No. Period.	Observed Paris Time. h. m. s.	Observer.	Equation of Light. m. s.	Reduced Time. h. m. s.
6959	Aug. 20 11 28 27	A.	+0 27	Oct. 8 5 19 55
	11 30 27	Sd.		21 55
6966	Sept. 9 13 23 1	B.	+2 59	34 50
	13 25 3	K.		36 52
6967	Sept. 12 9 53 31	B.	+3 20	16 51
	10 2 23	Sd.		25 40
	10 15 9	A.		38 26
	10 16 54	O.		40 11
6973	Sept. 29 14 53 52	B.	+5 11	25 42
6974	Oct. 2 11 43 45	K.	+5 27	26 58
	11 46 3	A.		29 16
	11 46 4	B.		29 17
	11 58 12	N.		41 25
	12 0 44	O.		43 57
	12 1 52	Sd.		45 5
6981	Oct. 22 13 18 28	Sd.	+6 55	20 58
6983	Oct. 28 7 1 57	A.	+7 12	26 58
	7 7 39	K.		32 40
	7 11 30	H.		36 31
	7 18 48	N.		43 49
6989	Nov. 14 11 51 46	B.	+7 35	23 52
6997	Dec. 7 10 19 31	A.	+7 2	20 0
	10 23 10	Sd.		23 39
	10 25 31	K.		Oct. 8 5 26 0

To obtain from these numbers the most probable result, we should not take the mean directly, but if a denote the probable irregularity of the period, and b the probable error of observation, each one of the n observations of the same minimum will receive the value $1 : (na^2 + b^2)$. But since, as we have already seen, a^2 is at any rate very small in comparison with b^2, and the number of observations yet too small to determine a with any degree of accuracy, the simple mean will still afford the most trustworthy result. This is, for the epoch 6976, Oct. 8, $5^{h.}\ 30^{m.}\ 27^{s.}.0$ M. T. Paris. The period might, according to the table already given, be assumed for the next year as about $2^{d.}\ 20^{h.}\ 48^{m.}\ 51^{s.}.5$. But since the above result for Ep. 6976 compared with that which 18 observations furnish for Ep. 6870, namely, 1853, Dec. 8, $7^{h.}\ 7^{m.}\ 24^{s.}.6$ M. T. Paris, gives the decidedly longer period $2^{d.}\ 20^{h.}\ 48^{m.}\ 53^{s.}.8 \pm 1^{s.}.04$, I have, in computing the following table of minima for the year 1855, combined the period $2^{d.}\ 20^{h.}\ 48^{m.}\ 52^{s.}$ with the epoch for 1854, Oct. 8. According to this, the first minimum of the year occurs Jan. 2, $0^{h.}\ 38^{m.}\ 57^{s.}$ M. T. Washington, and the subsequent ones which occur in the hours of darkness are stated below, and already corrected for the equation of light, so that the time for observation is directly given.

MINIMA OF *ALGOL* VISIBLE IN AMERICA, 1855.

Washington Mean Time.

	h. m.		h. m.		h. m.		h. m.		h. m.		h. m.
Jan. 7	18 12	Feb. 22	15 19	July 1	16 3	Aug. 22	6 37	Oct. 15	17 59	Nov. 30	15 0
10	15 1	25	12 8	4	12 52	Sept. 2	17 49	18	14 48	Dec. 3	11 49
13	11 50	28	8 57	7	9 41	5	14 38	21	11 36	6	8 38
16	8 40	Mar. 17	13 54	24	14 31	8	11 27	24	8 25	9	5 27
19	5 29	20	10 43	27	11 20	11	8 16	Nov. 7	16 29	20	16 43
30	16 46	23	7 32	30	8 9	25	16 19	10	13 18	23	13 32
Feb. 2	13 35	Apr. 12	9 16	Aug. 13	16 11	28	13 7	13	10 7	26	10 21
5	10 24	May 19	15 52	16	12 59	Oct. 1	9 56	16	6 56	29	7 10
8	7 13	June 11	14 22	19	9 48	4	6 45	27	18 11		

FR. ARGELANDER.

Bonn, 1854, *December* 9.

CORRECTION.

In a communication from Prof. Gerling, published in the *Astronomische Nachrichten*, No. 926, is a quotation from a letter of Dr. Moesta at Santiago de Chile, alluding to an important "typographical error" in a letter from him, published in the *Astronomical Journal*, No. 67, in which, instead of "12 or 15 minutes before the beginning," &c., should be read "10 or 12 seconds before the beginning," &c. Reference to the original manuscript shows that the error was one of the pen, not of the press.

G.

PROBLEMS OF SPHERICAL MECHANICS.

By Mr. EDWARD COMBESCURE,

PROFESSOR IN NEW YORK.

(*Continued from page 52.*)

We have then

$$\cos^2 \tfrac{1}{2}\, n\omega = \frac{1}{1 + \operatorname{tang}^2 \frac{1}{2}\, n\omega} = \frac{\sin(\alpha - \varepsilon)\, z^2}{\sin(\alpha - \varepsilon) + \sin(\alpha + \varepsilon)\, z^2}$$

$$d\omega = \frac{2}{n}\sqrt{\frac{\sin(\alpha + \varepsilon)}{\sin(\alpha - \varepsilon)}} \,.\, dz \cos^2 \tfrac{1}{2}\, n\omega = \frac{2\sqrt{\sin(\alpha - \varepsilon)\sin(\alpha + \varepsilon)}\, dz}{\sin(\alpha - \varepsilon) + \sin(\alpha + \varepsilon)\, z^2}$$

and consequently putting

$$\frac{c\,n}{\sqrt{\sin \overline{\alpha - \varepsilon}\, \sin(\alpha + \varepsilon)}} = n'$$

$$n'\, dt = \frac{2\,\{\sin(\alpha - \varepsilon) + \sin(\alpha + \varepsilon)\, z^2\}\, dz}{z^4 + 2\cos 2\,\varepsilon \,.\, z^2 + 1}$$

an expression which, observing that the denominator is equivalent to

$$(z^2 + 2\sin\varepsilon \,.\, z + 1)\,(z^2 - 2\sin\varepsilon \,.\, z + 1)$$

and introducing the angle ϕ, may also be written

$$n'\, dt = -\cos\alpha\, \frac{d \sin\varepsilon \sin\phi}{1 - \sin^2\varepsilon \sin^2\varphi} + \sin\alpha\, \frac{d \cos\varepsilon \operatorname{tang}\varphi}{1 + \cos^2\varepsilon \operatorname{tang}^2\varphi}\,.$$

Then integrating we obtain

$$(i.) \qquad n'\, t = \tfrac{1}{2}\cos\alpha\, l \,.\, \frac{1 - \sin\varepsilon\sin\varphi}{1 + \sin\varepsilon\sin\varphi} + \sin\alpha \operatorname{arc}\left[\operatorname{tang} = \cos\varepsilon \operatorname{tang}\varphi\right]$$

t commencing with ϕ.

The preceding expressions of $\sin^2\varrho$ &c. in terms of z give

$$\cos\varrho\, d\omega = \operatorname{cotang}\varrho \sin\varrho\, d\omega = \frac{2\sqrt{\sin(\alpha - \varepsilon)\sin(\alpha + \varepsilon)}}{n} \,.\, \frac{\cos(\alpha - \varepsilon) + \cos(\alpha + \varepsilon)\, z^2}{\sin(\alpha - \varepsilon) + \sin(\alpha + \varepsilon)\, z^2} \,.\, \frac{dz}{\sqrt{z^4 + 2\cos 2\,\varepsilon\, z^2 + 1}}$$

that is to say,

$$\cos\varrho\, d\omega = \frac{\sqrt{\sin(\alpha - \varepsilon)\sin(\alpha + \varepsilon)}}{n}\, \frac{\cos\alpha\cos\varepsilon + \sin\alpha\sin\varepsilon\cos\phi}{\sin\alpha\cos\varepsilon - \cos\alpha\sin\varepsilon\cos\varphi}\, \frac{d\varphi}{\sqrt{1 - \sin^2\varepsilon\sin^2\varphi}}\,.$$

The second member, multiplied above and below by

$$\sin\alpha\cos\varepsilon + \cos\alpha\sin\varepsilon\cos\varphi$$

separates itself into the two portions

$$\frac{\sqrt{\sin(\alpha - \varepsilon)\sin(\alpha + \varepsilon)} \,.\, \sin\varepsilon\cos\varepsilon\cos\phi\, d\varphi}{n\,(\sin^2\alpha - \sin^2\varepsilon + \cos^2\alpha\sin^2\varepsilon\sin^2\varphi)\sqrt{1 - \sin^2\varepsilon\sin^2\phi}} \quad \text{and} \quad \frac{\sqrt{\sin(\alpha - \varepsilon)\sin(\alpha + \varepsilon)}\,\sin\alpha\cos\alpha\sqrt{1 - \sin^2\varepsilon\sin^2\varphi}\, d\varphi}{n\,(\sin^2\alpha - \sin^2\varepsilon + \cos^2\alpha\sin^2\varepsilon\sin^2\varphi)}\,.$$

Making in these the two substitutions,

$$\sin\varepsilon\sin\varphi = \sin\chi$$

$$\operatorname{cotang}\varphi = \cos\varepsilon \operatorname{tang}\psi$$

and having regard to the indefinite expression of the sectorial area

$$\int (d\omega - \cos\varrho\, d\omega)$$

we shall find from the result obtained the following expression, in which

$$\sqrt{\sin(\alpha - \varepsilon)\sin(\alpha + \varepsilon)} = \xi.$$

$$(h.)\qquad A = \omega - \omega_0 + \frac{1}{n}\left(\operatorname{arc}\left[\operatorname{tang} = \frac{\sin\epsilon}{\xi}\right] - \operatorname{arc}\left[\operatorname{tang} = \frac{\cos\epsilon \operatorname{tang}\chi}{\xi}\right]\right) - \int_0^{\psi} \frac{\sqrt{\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon)}}{n \operatorname{tang}\alpha\left(1 - \frac{\sin^2\varepsilon}{\sin^2\alpha}\sin^2\psi\right)} \frac{d\psi}{\sqrt{1-\sin^2\varepsilon\sin^2\psi}}$$

the definite area A being supposed to commence with ψ, and the angle ω_0 being determined by the equation

$$\operatorname{tang}\tfrac{1}{2}n\omega_0 = \sqrt{\frac{\sin(\alpha+\varepsilon)}{\sin(\alpha-\varepsilon)}} \quad \text{which makes } \varrho_0 = \alpha.$$

To rectify the curve, it will be observed that

$$\sin^2\varrho\, d\omega^2 = \frac{1}{n^2}\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon). \frac{4\,dz^2}{z^4 + 2\cos 2\varepsilon\, z^2 + 1} = \frac{\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon)}{n^2} \frac{d\varphi^2}{1-\sin^2\varepsilon\sin^2\varphi}$$

$$\frac{d\varrho}{\sin^2\varrho} = \frac{2\sin 2\varepsilon\, z\, dz}{\{\sin(\alpha-\varepsilon) + \sin(\alpha+\varepsilon)\, z^2\}^2}$$

$$d\varrho = \frac{2\sin 2\varepsilon\, z\,.\,dz}{z^4 + 2\cos 2\varepsilon\, z^2 + 1} = \frac{\sin\varepsilon\cos\varepsilon\sin\varphi\, d\varphi}{1-\sin^2\varepsilon\sin^2\varphi}$$

and in consequence, by putting

$$-\sin^2\varepsilon\left(1 - \frac{n^2\cos^2\varepsilon}{\sin^2\alpha - \sin^2\varepsilon}\right) = \mp \operatorname{tang}^2\gamma,$$

$$(k.)\qquad s = \frac{\sqrt{\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon)}}{n}\int_0^{\varphi} \frac{\sqrt{1 \pm \operatorname{tang}^2\gamma\sin^2\varphi}}{1-\sin^2\varepsilon\sin^2\varphi}\, d\varphi.$$

When we have $a < b$ we take

$$a + b = \operatorname{cotang}(\varepsilon - \alpha)$$

$$b - a = \operatorname{cotang}(\varepsilon + \alpha)$$

$$\operatorname{tang}\tfrac{1}{2}n\omega = \sqrt{\frac{\sin(\varepsilon+\alpha)}{\sin(\varepsilon-\alpha)}}\operatorname{tang}\tfrac{1}{2}\varphi\,; \quad \operatorname{tang}\tfrac{1}{2}\varphi = z\,;$$

which will give

$$\operatorname{cotang}\varrho = \frac{\cos(\varepsilon-\alpha) - \cos(\varepsilon+\alpha)\, z^2}{\sin(\varepsilon-\alpha) + \sin(\varepsilon+\alpha)\, z^2}$$

whence

$$\sin^2\varrho = \frac{\{\sin(\varepsilon-\alpha) + \sin(\varepsilon+\alpha)\, z^2\}^2}{z^4 - 2\cos 2\varepsilon\,.\,z + 1}.$$

We shall therefore have

$$d\omega = \frac{2\sqrt{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}}{n} \frac{dz}{\sin(\varepsilon-\alpha) + \sin(\varepsilon+\alpha)\, z^2}$$

$$c\,dt = \sin^2\varrho\, d\omega = \frac{2\sqrt{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}}{n} \frac{\{\sin(\varepsilon-\alpha) + \sin(\varepsilon+\alpha)\, z^2\}\, dz}{z^4 - 2\cos 2\varepsilon\, z^2 + 1}$$

and by putting $n' = \dfrac{c\,n}{\sqrt{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}}$ and introducing the angle φ

$$n'\,dt = -\sin\alpha\,\frac{d\cos\varepsilon\sin\varphi}{1-\cos^2\varepsilon\sin^2\varphi} + \cos\alpha\,\frac{d\sin\varepsilon\operatorname{tang}\varphi}{1+\sin^2\varepsilon\operatorname{tang}^2\varphi}$$

there will result from the integration

$$n't = \tfrac{1}{2}\sin\alpha\, l\,.\,\frac{1-\cos\varepsilon\sin\varphi}{1+\cos\varepsilon\sin\varphi} + \cos\alpha\operatorname{arc}\left[\operatorname{tang} = \sin\varepsilon\operatorname{tang}\varphi\right].$$

We have then

$$\cos\varrho\, d\omega = \frac{\sqrt{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}}{n}\,.\,\frac{\sin\alpha\sin\varepsilon + \cos\alpha\cos\varepsilon\cos\varphi}{\cos\alpha\sin\varepsilon - \sin\alpha\cos\varepsilon\cos\varphi} \frac{d\varphi}{\sqrt{1-\cos^2\varepsilon\sin^2\varphi}}$$

which by making

$$\cos\varepsilon\sin\varphi = \sin\chi.$$

$$(h'.)\qquad A = \omega - \frac{1}{n}\operatorname{arc}\left[\operatorname{tang} = \frac{\sin\varepsilon\operatorname{tang}\chi}{\sqrt{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}}\right] - \int_0^{\phi} \frac{\sqrt{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}\,.\,\sin\alpha\cos\alpha\sqrt{1-\cos^2\varepsilon\sin^2\varphi}}{n(\sin^2\varepsilon - \sin^2\varepsilon - \sin^2\alpha\cos^2\varepsilon\sin^2\varphi)}\,.\,d\varphi$$

the area A commencing with ω or with ϕ.

Next,

$$\sin^2\varrho\, d\omega^2 = \frac{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}{n^2} \frac{d\varphi^2}{1-\cos^2\varepsilon\sin^2\varphi}\,;\quad d\varrho = \frac{\sin\varepsilon\cos\varepsilon\sin\varphi\, d\phi}{1-\cos^2\varepsilon\sin^2\varphi}\,;$$

whence putting

$$-\cos^2\varepsilon\left(1 - \frac{n^2\sin^2\varepsilon}{\cos^2\varepsilon - \sin^2\alpha}\right) = \mp\operatorname{tang}^2\gamma,$$

$$(k'.)\qquad s = \frac{\sqrt{\sin(\varepsilon-\alpha)\sin(\varepsilon+\alpha)}}{n}\int_0^{\varphi} \frac{\sqrt{1 \pm \operatorname{tang}^2\gamma\sin^2\varphi}}{1-\cos^2\varepsilon\sin^2\varphi}\, d\varphi.$$

6. The form which has been examined in the preceding number degenerates into a spherical conic when n becomes equal to unity, and may be considered as obtained by contracting or dilating uniformly such a conic, about the origin. The origin is then the focus of the conic, 2α its major axis, 2ε the focal distance. The central force is reduced in this case to

$$F(\varrho) = -\frac{k\,c^2}{\sin^2\varrho}$$

in which

$$k = \frac{\sin 2\alpha}{2\sin(\alpha+\varepsilon)\sin(\pm(\alpha-\varepsilon))}$$

the upper sign holding for the ellipse, and the lower for the hyperbola.

From this, and from our having always considered attracting forces as negative, it results that *the spheric central force necessary for causing a material point to describe a spherical conic is an attractive force whose intensity varies in the inverse ratio of the square of the sine of the geodetic distance.*

As for the equation establishing a dependence between the time and the co-ordinates, this preserves the same form as before, and it is quite useless to transcribe it. It ought to reproduce the well-known formula which corresponds to the plane ellipse when the radius of the sphere is supposed infinite, — or what comes to the same thing, when, the radius remaining always equal to unity, the geodetic distances are supposed to decrease indefinitely. By developing in series the logarithmic term of the formula (i), and only retaining in each member the infinitesimals of the first order, it gives

$$n' t = \alpha \,.\, \varphi - \varepsilon \sin \varphi$$

in which the major axis and the focal distance 2ε may be indefinitely elongated in the tangent plane which contains them.

But let us return to the spherical conics, and see what geometrical signification may be given to the angle φ, and let us consider at first the ellipse.

By virtue of the trigonometric formula

$$\text{tang}\, \tfrac{1}{2} A \ \text{tang}\, \tfrac{1}{2} B = \frac{\sin \frac{1}{2} (a + b - c)}{\sin \frac{1}{2} (a + b + c)}$$

where a, b, c are sides, and A, B, angles of a spherical triangle, we have, on denoting by ω' and ω'' the angles with the major axis, formed by the radius-vectors ϱ and ϱ' extending from the foci F, F', and counted from one focus toward the other, taking $c = 2\varepsilon$, $a = \varrho$, $b = \varrho'$, and observing that for the ellipse $\varrho + \varrho' = 2\alpha$, the equation

$$\text{tang}\, \tfrac{1}{2}\, \omega' \ \text{tang}\, \tfrac{1}{2}\, \omega'' = \frac{\sin (\alpha - \varepsilon)}{\sin (\alpha + \varepsilon)}$$

in which $\omega' = \pi - \omega$. Then, since we have put

$$\text{tang}\, \tfrac{1}{2}\, \omega = \sqrt{\frac{\sin (\alpha + \varepsilon)}{\sin (\alpha - \varepsilon)}}\ \text{tang}\, \tfrac{1}{2}\, \varphi$$

it results that the product tang $\frac{1}{2}\, \varphi$ tang $\frac{1}{2}\, \omega'$ is constant, and that consequently, if at any point F_1 of the major axis, situated on the side of the angle ω' at a distance 2η from F, we construct an angle equal to the angle φ and turned toward F, the side ϱ, which forms it, will intersect the vector ϱ produced at a point M' constantly situated upon a conic having F and F_1 for its foci, and the major axis 2ϖ of which will be determined by the relation

$$\frac{\sin (\varpi - \eta)}{\sin (\varpi + \eta)} = \sqrt{\frac{\sin (\alpha - \varepsilon)}{\sin (\alpha + \varepsilon)}}\,.$$

It will be most simple to suppose $\eta = \varepsilon$, so that the trajectory and the auxiliary spherical ellipse have the same foci; and as in all cases

$$\text{tang}\, \tfrac{1}{2}\, \omega'' = \sqrt{\frac{\sin (\alpha - \varepsilon)}{\sin (\alpha + \varepsilon)}}\,.\ \text{tang}\, \tfrac{1}{2}\, \varphi$$

we perceive that this same auxiliary ellipse envelopes here the proposed one in all sides. The angle φ might, on the sphere, and consequently in the plane, receive the name of *exfocic* anomaly. From the stand-point of geometric and mechanic consideration this exfocic anomaly would appear to me to possess an advantage over what is called in planetary motion the eccentric anomaly, on account of the perpetual eclipse of the fictitious star M' examined from the centre of action, and of the part which the second focus is called upon to play, being entirely dissembled, in the use of the eccentric anomaly. Moreover, the same angle ϕ, which commences with ω, furnishes immediately the rectification of both of the conics, as has been indicated by what precedes, and as I shall completely demonstrate immediately.

In the hyperbola the auxiliary φ will receive an analogous interpretation. For if in the formula of spherical trigonometry

$$\frac{\text{tang}\, \frac{1}{2} A}{\text{tang}\, \frac{1}{2} B} = \frac{\sin \frac{1}{2} (c - a + b)}{\sin \frac{1}{2} (c - b + a)}$$

we take $c = 2\varepsilon$, $b = \varrho'$, $a = \varrho$, and denote by ω' the angle which ϱ' makes with the transverse axis; we shall have, since $\varrho' - \varrho = 2\alpha$,

$$\frac{\text{tang}\, \frac{1}{2}\, \omega}{\text{tang}\, \frac{1}{2}\, \omega'} = \frac{\sin (\varepsilon + \alpha)}{\sin (\varepsilon - \alpha)}\,.$$

Taking from F towards F_1, $FF_1 = 2\eta$, drawing the vector ϱ_1 from the point F_1 with an inclination φ to 2η, which vector meets at M' either ϱ' or its prolongation, putting $FM' = \varrho_0$, $F_1 M' = \varrho_1$, and subjecting ϱ_0 and ϱ_1 to the condition $\varrho_1 - \varrho_0 = 2\varpi$ which belongs to a hyperbola with the variables ϱ_0 and ϱ_1, we shall have for the required formula

$$\frac{\text{tang}\, \frac{1}{2}\, \omega}{\text{tang}\, \frac{1}{2}\, \varphi} = \frac{\sin (\eta + \varpi)}{\sin (\eta - \varpi)} = \sqrt{\frac{\sin (\varepsilon + \alpha)}{\sin (\varepsilon - \alpha)}}\,.$$

For the sake of the greatest simplicity we will put $\eta = \varepsilon$, which will give a hyperbola biconfocal with the one proposed, and enveloping it on all sides; that is to say, having a less transverse axis.

If in the formula (k) of the preceding number, we introduce the hypothesis $n = 1$, we shall have

$$s = \sqrt{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)} \int_0^{\varphi} \frac{\sqrt{1 + \frac{\sin^2 \varepsilon \cos^2 \alpha}{\sin^2 \alpha - \sin^2 \varepsilon} \sin^2 \varphi}}{1 - \sin^2 \varepsilon \sin^2 \varphi}\, d\varphi$$

and assuming

$$\text{tang}^2 \gamma = \frac{\sin^2 \varepsilon \cos^2 \alpha}{\sin^2 \alpha - \sin^2 \varepsilon}, \cos \gamma \cos \varepsilon = \cos K, \text{tang}\, \phi = \cos \gamma\, \text{tang}\, \psi,$$

we have

$$s = \cos \gamma \sqrt{\sin (\alpha - \varepsilon) \sin (\alpha + \varepsilon)} \int_0^{\psi} \frac{d\psi}{(1 - \sin^2 K \sin^2 \psi) \sqrt{1 - \sin^2 \gamma \sin^2 \psi}}\,.$$

for the arc of the spherical ellipse counted from the extremity of the major axis. Since $-\sin^2 K = -1 + \cos^2 \gamma \cos^2 \varepsilon$, it will be seen that the parameter is circular.

The formula (k) of the same number will give us similarly for the hyperbola

$$s = \sqrt{\sin (\varepsilon - \alpha) \sin (\varepsilon + \alpha)} \int_0^{\phi} \frac{\sqrt{1 + \text{tang}^2 \gamma \sin^2 \varphi}}{1 - \cos^2 \varepsilon \sin^2 \varphi}\, d\varphi$$

in which

$$\text{tang}^2 \gamma = \frac{\sin^2 \alpha \cos^2 \varepsilon}{\sin^2 \varepsilon - \sin^2 \alpha}\,;$$

and by making

$$\cos \gamma \sin \varepsilon = \cos K\,, \quad \text{tang}\, \varphi = \cos \gamma\, \text{tang}\, \psi\,,$$

we shall have

$$s = \cos \gamma \sqrt{\sin (\varepsilon - \alpha) \sin (\varepsilon + \alpha)} \int_0^{\psi} \frac{d\psi}{(1 - \sin^2 K \sin^2 \psi) \sqrt{1 - \sin^2 \gamma \sin^2 \psi}}$$

a function of the third class, with a circular parameter. The arc is still counted from the extremity of the transverse axis.

As for the sectorial area belonging to the ellipse, the formula (h) of the number cited presents it with a circular parameter, whatever the value of n, and therefore when $n = 1$. But the formula (h'), which comprises the case of the hyperbola, cannot be reduced to the same form as (h), because φ cannot reach $\frac{1}{2}\pi$. Making the radical pass to the denominator, and employing the parametric transformations of LEGENDRE, we may express it in terms of φ by functions of the first and third classes with circular parameter.

7. Inasmuch as I have been led to the consideration of spherical conics, it will perhaps not be inappropriate to make with them an application of the formulas of Nos. 3 and 4. I will confine myself entirely to the ellipse in order to avoid an excess of notation, or the necessity of going twice through nearly the same computations. According to its equation

$$u = \text{cotang}\,\varrho = \frac{\sin 2\alpha}{\cos 2\varepsilon - \cos 2\alpha} + \frac{\sin 2\varepsilon}{\cos 2\varepsilon - \cos 2\alpha}\cos\omega$$

the formula (c) gives

$$\frac{2}{c^2}\int F\varrho\, d\varrho = \frac{-\cos 2\alpha + \sin 2\alpha\,\text{cotang}\,\varrho}{\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon)} = \frac{+\sin\varrho'}{\sin(\alpha-\varepsilon)\sin(\alpha+\varepsilon)\sin\varrho}$$

by reason of $\varrho + \varrho' = 2\alpha$. We have then by virtue of the equation (e)

$$\sin^2 p = \sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)\frac{\sin\varrho}{\sin\varrho'}$$

and denoting by p' the spheric perpendicular let fall from the second focus upon the tangent, symmetry will give

$$\sin^2 p' = \sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)\frac{\sin\varrho'}{\sin\varrho}.$$

Then

$$\sin p \sin p' = \sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)$$

and therefore

$$\frac{\sin p}{\sin p'} = \frac{\sin\varrho}{\sin\varrho'}$$

well-known relations, which for the hyperbola should have the second members negative. The latter shows, by the way, that the tangent forms equal angles with the two radius-vectors drawn from the foci, and from the former we deduce

$$\sin\mu = \frac{\sin p}{\sin\varrho} = \frac{\sin p'}{\sin\varrho'} = \sqrt{\frac{\sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)}{\sin\varrho\sin\varrho'}}.$$

Let $MN = N$ be the spherical normal, terminating at the point N of the major axis; we have

$$\frac{\sin F'N}{\sin FN} = \frac{\sin\varrho'}{\sin\varrho},$$

from which, and from $FN + F'N = 2\varepsilon$ we have

$$\sin FN = \frac{\sin 2\varepsilon\sin\varrho}{\sqrt{\sin^2\varrho + \sin^2\varrho' + 2\cos 2\varepsilon\sin\varrho\sin\varrho'}}$$

which can, by adding and subtracting under the radical the two equivalent quantities $\sin^2(\varrho+\varrho')$ and $\sin^2 2\alpha$, be written

$$\sin FN = \frac{\sin 2\varepsilon\sin\varrho}{\sqrt{\sin^2 2\alpha + 2(\cos 2\varepsilon - \cos 2\alpha)\sin\varrho\sin\varrho'}}$$

and since in every triangle we have for the bisectrix MN

$$\cos MN = \frac{\cos\varrho\sin NF' + \cos\varrho'\sin NF}{\sin 2\varepsilon} = \frac{\sin 2\alpha}{\sin 2\varepsilon}\,\frac{\sin NF}{\sin\varrho}$$

we may immediately conclude from this and from the expression for $\sin FN$

$$\text{tang}\,MN = \frac{\sqrt{\sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)}}{\sin\alpha\cos\alpha}\sqrt{\sin\varrho\sin\varrho'}$$

or

$$\text{tang}\,N = \frac{\sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)}{\sin\alpha\cos\alpha\sin\mu}.$$

Let q be the spherical projection of the normal upon the radius-vector; — then

$$\text{tang}\,q = \text{tang}\,N\sin\mu = \frac{\sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)}{\sin\alpha\cos\alpha}$$

and this projection is therefore constant for spherical conics.

From the expression above given for $\sin p$, we infer

$$\frac{d\sin p}{\sin\varrho\, d\varrho} = \sqrt{\sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)}\,\frac{\sin\alpha\cos\alpha}{(\sin\varrho\sin\varrho')^{\frac{3}{2}}}$$

and the formula (B) of No. 4 will then give for the spheric radius of curvature

$$\text{cotang}\,R = \sqrt{\sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)}\,\frac{\sin\alpha\cos\alpha}{(\sin\varrho\sin\varrho')^{\frac{3}{2}}}$$

and therefore

$$\text{tang}\,R = \left(\frac{\sin\alpha\cos\alpha}{\sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)}\right)^2\text{tang}^3 N$$

a relation analogous to that of the plane conics.

Denote by S, S' the vectors proceeding from the foci, and terminating at the spheric centre of curvature. The figure gives

$$\cos S = \cos\varrho\cos R + \sin\varrho\sin R\sin\mu$$
$$\cos S' = \cos\varrho'\cos R + \sin\varrho'\sin R\sin\mu$$

whence by addition and subtraction

$$\tau = \sin\tfrac{1}{2}(S'+S)\sin\tfrac{1}{2}(S'-S) = (\sin\alpha\cos R - \cos\alpha\sin\mu\sin R)\sin\tfrac{1}{2}(\varrho'-\varrho)$$
$$\xi = \cos\tfrac{1}{2}(S'+S)\cos\tfrac{1}{2}(S'-S) = (\cos\alpha\cos R + \sin\alpha\sin\mu\sin R)\cos\tfrac{1}{2}(\varrho'-\varrho)$$

and from these, having regard to the expressions for $\sin\mu$ and $\text{tang}\,R$

$$\frac{\tau}{\xi} = \text{cotang}\,\alpha\,\text{tang}^3\tfrac{1}{2}(\varrho'-\varrho).$$

(*To be continued.*)

FROM A LETTER OF PROFESSOR ARGELANDER TO THE EDITOR.

Bonn, 1854, *December* 9.

I HAVE not been able to observe *Euphrosyne* since my letter of Nov. 4; the excessively bad weather, and the necessity of making use of the few clear moments for other purposes, have prevented. But I have determined my comparison-stars anew, and thus improved the positions sent you, which stand at present thus: —

1854.	M.T. Bonn.	㉛ α	㉛ δ	No. of Obs.	*	1854.	M. T. Bonn.	㉛ α	㉛ δ	No. of Obs.	*
	h. m. s.	° ′ ″	° ′ ″				h. m. s.	° ′ ″	° ′ ″		
Sept. 29	13 54 33.3	23 23 49.0	—2 34 22.6	6	α	Oct. 26	12 15 58.6	16 13 23.6	—1 33 45.9	6	η
30	11 27 48.2	10 43.2	33 18.7	4	α		12 25 49.2	16 13 22.7	33 36.2	5	θ
	11 46 30.7	23 10 24.6	33 14.9	6	β	27	9 55 20.4	15 59 24.4	30 24.0	4	η
Oct. 1	11 3 6.1	22 55 52.1	32 8.3	8	γ		10 11 12.0	59 21.1	30 18.7	5	θ
2	11 7 59.7	22 40 49.3	2 30 48.3	8	γ	28	10 9 46.0	44 7.1	26 33.3	8	θ
21	11 35 16.6	17 33 24.2	1 50 40.9	8	δ	29	10 50 42.9	28 35.2	22 27.1	9	ι
22	11 42 19.8	17 14.3	47 39.9	6	ε	30	9 55 16.5	15 14 19.4	18 32.9	8	ι
	11 58 58.0	17 5.1	47 24.6	1	ζ	31	10 19 26.6	14 59 28.1	14 19.8	6	ι
23	11 19 36.9	17 1 11.5	—1 41 21.1	9	ζ		10 32 32.4	14 59 24.9	—1 14 11.2	4	κ

These positions depend upon the following apparent places of the comparison-stars.

*	Date.	* α	* δ	*	Date.	* α	* δ
		° ′ ″	° ′ ″			° ′ ″	° ′ ″
α	Sept. 29	23 45 29.5	—2 53 31.8	η	Oct. 26	15 57 9.6	—2 2 45.2
	30	29.6	31.8		27	9.6	45.2
β	30	23 15 53.3	2 20 14.3	θ	26	16 6 36.0	1 13 3.2
γ	Oct. 2	22 42 26.2	2 29 48.2		28	36.0	3.3
δ	21	17 50 4.95	1 49 13.1	ι	29	14 54 59.9	1 22 3.2
ε	22	17 19 24.9	2 1 39.9		31	59.9	3.3
ζ	23	16 51 11.0	—1 45 4.9	κ	31	14 42 30.0	—1 2 33.5

ζ is 38 *Ceti*, and its mean position is taken from my Åbo Catalogue; the mean positions of the other stars for 1854 are given as follows by my meridian observations here.

*	Mag.	* α	* δ	No. of Obs.	*	Mag.	* α	* δ	No. of Obs.
		° ′ ″	° ′ ″				° ′ ″	° ′ ″	
κ	9	14 11 47.55	—1 2 51.68	2	δ	9.10	17 49 22.36	—1 49 31.76	3
ι	9	14 54 17.31	1 22 21.45	3	γ	9	22 41 45.97	2 30 7.55	2
η	8.9	15 56 26.92	2 3 3.54	3	β	8.9	23 15 13.36	2 20 33.54	2
θ	9	16 5 53.35	1 13 21.62	1	α	8.9	23 44 49.73	—2 53 51.13	2
ε	8.9	17 18 41.90	—2 1 58.50	2					

FR. ARGELANDER.

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ON A NEW THEOREM IN GEOMETRICAL PROGRESSION.

By L. W. MEECH.

The following propositions were investigated some time since by an induction from particular cases. Of late, on recurring to the subject, a demonstration was obtained, which unfolds a relation of unexpected simplicity between the degree of the power and the number of the terms. It is applicable to the properties of numbers, but more especially to the literal operations of analysis.

I. The sum of the squares of any *odd* number of terms in geometrical progression is exactly divisible by the sum of the terms.

For example, since the middle term is the square root of the product of the extremes, $x + \sqrt{xy} + y$, being a geometrical progression, will divide the sum of the squares $x^2 + xy + y^2$; the quotient is $x - \sqrt{xy} + y$.

In numbers, let 3 be a first term, and 2 the ratio; then 93, or the sum of the series 3, 6, 12, 24, 48, will be an exact measure of 3,069, the sum of their squares, giving 33 for the quotient.

II. The sum of the cubes, or third powers of terms, in geometrical series, is exactly divisible by the sum of the terms, except when the number of terms is a multiple of 3.

Thus it will be seen, on mere inspection, that the sum of the five terms x, xy, xy^2, xy^3, xy^4, will exactly divide the sum of their cubes, x^3, x^3y^3, x^3y^6, x^3y^9 x^3y^{12}.

III. The sum of the fourth powers of any *odd* number of terms in geometrical progression is always divisible by the sum of the terms, and by the sum of the squares of the terms.

IV. The sum of the fifth powers of a geometrical series is always divisible by the sum of the terms, except when the number of terms is 5, or a multiple of 5.

These propositions, however, and others, may all be included under the following general relation.

Theorem. — *When the terms of a Geometrical Progression are separately involved to the same power, the sum of these powers will be exactly divisible by the sum of the original terms, only when the degree of the power and the number of terms are prime to each other.*

Thus, in respect to the sixth powers, the successive numbers prime to 6 are 5; 7, 11, 13, 17 . . . . . Hence the sum of the sixth powers of so many terms in geometrical series will always be divisible by the sum of the first powers. The degree of the power and the number of terms are also interchangeable.

To demonstrate the Theorem here enunciated, let x denote the first term, y the ratio, and n the number of terms; then, taking the sum by the common rule,

$$x + xy + xy^2 \ldots\ldots + xy^{n-1} = x\,\frac{y^n - 1}{y - 1}. \qquad (1.)$$

Involving each term to the m^{th} power, and taking the sum,

$$x^m + x^m y^m + x^m y^{2m} \ldots\ldots + x^m y^{nm-m} = x^m\,\frac{y^{nm} - 1}{y^m - 1}. \qquad (2.)$$

The quotient of this sum, divided by the former, is

$$Q = x^{m-1}\,\frac{(y^{nm} - 1)\,(y - 1)}{(y^m - 1)\,(y^n - 1)}. \qquad (3.)$$

It remains to ascertain in what relation of the exponent m to the number of terms n, the numerator is divisible by the denominator. Now, in trigonometrical analysis, and by Cotes's Theorem, it is shown that the factors of $y^n - 1$ are $y - 1$, $y^2 - 2\,y\,\cos\frac{2\,\pi}{n} + 1$, $y^2 - 2\,y\,\cos\frac{4\,\pi}{n} + 1$, etc., to be continued till the number of dimensions is equal to n. If n be even, the last factor will be $y + 1$.

Since the number of dimensions is n only, the arcs of the successive cosines in the above-named factors will be $\frac{1\,(2\,\pi)}{n}$, $\frac{2\,(2\,\pi)}{n}$, $\frac{3\,(2\,\pi)}{n}$, ... $\frac{\frac{1}{2}\,(n-1)\,2\,\pi}{n}$; or, when n is even, the last term will take the form $\frac{\frac{1}{2}\,n\,(2\,\pi)}{n}$, which is π or 180°, corresponding to the factor $y + 1$. Thus the series of arcs regularly increases, but not beyond 180°, within which limit no value of a cosine, positive or negative, can be repeated; and hence no two factors of $y^n - 1$ can be equal.

As the factor for $y - 1$ occurs twice in the numerator of the expression for Q, and twice in the denominator, we assume it to be canceled. The remaining factors, being of the same form, differ only in their cosines. To determine whether the factors of the denominator are contained in the numerator, it is only necessary to compare their cosines in relation to equality, or more simply to compare their arcs, from which the common factor 2π may be omitted. The representation of the factors thus becomes, —

$$\text{For } y^{mn} - 1\,;\quad \frac{1}{mn},\ \frac{2}{mn},\ \frac{3}{mn},\ \ldots\ \frac{\frac{1}{2}(mn-1)}{mn}\,.$$

$$\text{For } y^{n} - 1\,;\quad \frac{1}{m},\ \frac{2}{m},\ \frac{3}{m},\ \ldots\ \frac{\frac{1}{2}(m-1)}{m}\,.$$

$$\text{For } y^{n} - 1\,;\quad \frac{1}{n},\ \frac{2}{n},\ \frac{3}{n},\ \ldots\ \frac{\frac{1}{2}(n-1)}{n}\,.$$

Changing these fractions to a common denominator, and omitting it, we have to designate the factors as follows : —

(4.) For $y^{mn} - 1$; $1, 2, 3, 4, 5, \ldots \frac{1}{2}(mn - 1)$.

(5.) For $y^{m} - 1$; $n, 2n, 3n, 4n, \ldots \frac{1}{2}n(m - 1)$.

(6.) For $y^{n} - 1$; $m, 2m, 3m, 4m, \ldots \frac{1}{2}m(n - 1)$.

Recurring to equation (2), it will at once be seen that $y^{mn} - 1$ is always divisible by $y^m - 1$; and as m and n enter symmetrically, so $y^{mn} - 1$ is always divisible by $y^n - 1$. From this it follows that the series (4) comprehends either of the series (5) or (6) separately ; hence it will comprehend both of them together, provided their terms are all unlike.

To examine this last condition, suppose m and n to be prime to each other, or to have no common factor. Under this supposition, no term of the series $n, 2n, 3n, \ldots mn$ could be equal to a term of the series $m, 2m, 3m, \ldots nm$, till we come to the last terms. For if previous terms could be equal, let them be denoted by $m'n = n'm$, whence $m : n :: m' : n'$; that is, the ratio of m to n would be expressible by two less whole numbers, which is plainly impossible, so long as m and n are prime to each other. But neither of the series (5), (6) extends so far as the term mn ; consequently no two of their terms can be equal, under the given supposition, and hence they will each and all be contained in the series (4). Hence all their corresponding factors in $y^m - 1$ and $y^n - 1$ will be contained in $y^{mn} - 1$; and supposing the division executed, Q will represent an exact quotient.

The truth of the theorem being thus established when n and m are prime to each other, it remains to be shown *conversely*, that, when n and m are not prime to each other, or when they have a common factor, the proposed division is impossible. In the latter case, let r denote the common factor, and let m become rm', and n become rn' ; we have then, in place of the series (4), (5), (6), —

For $y^{mn} - 1$; $1, 2, 3, 4, 5, \ldots \frac{1}{2}(m'n'r^2 - 1)$. (7.)

For $y^{m} - 1$; $rn, 2rn', 3rn', 4rn', \ldots \frac{1}{2}rn'(rm' - 1)$. (8.)

For $y^{n} - 1$; $rm', 2rm', 3rm', \ldots \frac{1}{2}rm'(rn' - 1)$. (9.)

Now the m'^{th} term of the series (8) will evidently be equal to the n'^{th} term of the series (9), if they extend so far as these terms, or farther. This will take place when, in the last term of (8), $\frac{1}{2}(rm' - 1) > m'$, which may be reduced to the form $(r - 2)m' > 1$; and similarly for (9) to contain n' terms, or more, $(r - 2)n' > 1$. From this inequality and the preceding, it follows that, when m' and n' are each greater than 1, and r' is greater than 2, at least one term in (8) will be equal to a term in (9), but not occurring twice in (7), Q cannot under this supposition represent an exact quotient.

In the particular instance where $r = 2$, both rn' and rm' will be even numbers, and then, as stated before, $y^m - 1$ and $y^n - 1$ will each contain the factor $y + 1$, which being contained only once in $y^{mn} - 1$, the proposed division cannot be exact. Thus, whether the common factor in m and n be 2, or greater than 2, the division indicated by Q is impossible.

But when m and n are prime to each other, it has already been shown that the division is always possible. This simple relation or criterion, which might have been deduced, by a similar process of demonstration, from the theory of *binomial equations*, affords a convenient aid for estimating at first view, without trial, the factors of any analytic expression, whose terms succeed each other in a constant ratio, or where each term, divided by the preceding, gives the same quotient successively.

PROBLEMS OF SPHERICAL MECHANICS.

By Mr. EDWARD COMBESCURE,
PROFESSOR IN NEW YORK.

(*Concluded from page* 63.)

The two preceding equations give also

$$\cos R = \frac{\tau \sin \alpha}{\sin \frac{1}{2}(\varrho' - \varrho)} + \frac{\xi \cos \alpha}{\cos \frac{1}{2}(\varrho' - \varrho)}$$

$$\sin \mu \sin R = -\frac{\tau \cos \alpha}{\sin \frac{1}{2}(\varrho' - \varrho)} + \frac{\xi \sin \alpha}{\cos \frac{1}{2}(\varrho' - \varrho)}$$

and since

$$\sin\mu = \frac{\sqrt{\sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)}}{\sqrt{\cos^2\tfrac{1}{2}(\varrho'-\varrho)-\cos^2\alpha}} = \sqrt{\frac{\sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)}{\sin\alpha\cos\alpha}}\;\frac{\sqrt{\xi^{\frac{2}{3}}\cos^{\frac{4}{3}}\alpha+\tau^{\frac{2}{3}}\sin^{\frac{4}{3}}\alpha}}{\sqrt{\xi^{\frac{2}{3}}\dfrac{\sin\alpha}{\cos^{\frac{1}{3}}\alpha}-\tau^{\frac{2}{3}}\dfrac{\cos\alpha}{\sin^{\frac{1}{3}}\alpha}}}$$

according to the previous expression of tang $\frac{1}{2}(\varrho'-\varrho)$ we have

$$\cos R = (\xi^{\frac{2}{3}}\cos^{\frac{2}{3}}\alpha+\tau^{\frac{2}{3}}\sin^{\frac{2}{3}}\alpha)^{\frac{3}{2}}$$

$$\sin R = \sqrt{\frac{\sin\alpha\cos\alpha}{\sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)}}\left(\xi^{\frac{2}{3}}\frac{\sin\alpha}{\cos^{\frac{1}{3}}\alpha}-\tau^{\frac{2}{3}}\frac{\cos\alpha}{\sin^{\frac{1}{3}}\alpha}\right)^{\frac{3}{2}}$$

and consequently, for the equation of the spheric evolute,

$$(\xi^{\frac{2}{3}}\cos^{\frac{2}{3}}\alpha+\tau^{\frac{2}{3}}\sin^{\frac{2}{3}}\alpha)^3+\frac{\sin\alpha\cos\alpha}{\sin(\alpha+\varepsilon)\sin(\alpha-\varepsilon)}\left(\xi^{\frac{2}{3}}\frac{\sin\alpha}{\cos^{\frac{1}{3}}\alpha}-\tau^{\frac{2}{3}}\frac{\cos\alpha}{\sin^{\frac{1}{3}}\alpha}\right)^3=1.$$

If it be desired to refer this curve to the center of the ellipse, denote by Δ the vector from this center, and by Θ the angle which it forms with this axis, below the polar axis, and we shall have

$$\xi = \cos\Delta\cos\varepsilon\,;\quad \frac{\tau}{\xi} = \text{tang}\,\varepsilon\;\text{tang}\,\Delta\cos\Theta.$$

8. Another hypothesis, which, it would seem, should lead to tolerably simple results, especially if based on the analogy of the preceding problem, and that of NEWTON, is that which would assign to the central force an intensity proportional to the sine of the geodetic distance; but it will be immediately perceived, that, with the exception of a difference in the pressure, we come upon the study of the laws of the conical pendulum, a study already too thoroughly prosecuted by several geometers, to render it necessary for us to dwell upon it here. I will merely remark, in passing, that according to the formulas (c) and (β) of Nos. 3 and 4, we have for this hypothesis

$$\sin p = \frac{a}{(b-\cos\varrho)^{\frac{1}{2}}}$$

$$\text{tang}\,R = \frac{2}{a}(b-\cos\varrho)^{\frac{3}{2}}$$

a and b being two constants.

Finally, if it be desired to know what is the force emanating from the center of a spherical conic, which is capable of causing a material point moving freely upon the sphere to describe this curve, its intensity will be found proportional to

$$\frac{\sin\varrho}{\cos^3\varrho}\text{ or tang}\,\varrho+\text{tang}^3\,\varrho.$$

I pass to the famous problem of the two fixed centers.

§ 2.

9. The present problem is to determine upon the sphere the motion of a material point, attracted or repelled by two central spheric forces, emanating from two fixed centers, and whose action follows respectively the law of the inverse ratio of the square of the sine of the geodetic distance.

Let F and F' be the two fixed centers upon the surface of the sphere; ϱ and ϱ', the vectors issuing from these points and terminating at the material point; $-g$ and $-g'$, the respective intensities of the forces when ϱ and ϱ' are separately equal to $\frac{1}{2}\pi$. The equation (A) of living forces, in No. 1, will here become, when the point F is taken as the origin of co-ordinates,

$$(1.)\qquad \frac{d\varrho^2+\sin^2\varrho\,d\omega^2}{dt^2} = 2\,(g\;\text{cotang}\,\varrho+g'\;\text{cotang}\,\varrho'+c)$$

where c is the constant of living forces. Supposing, moreover, that the polar axis passes through the second center F', and writing 2ε for $\gamma = FF'$, the equation (B) of No. 2 will give, in its turn,

$$\frac{d}{dt}\left(\sin^2\varrho\,\frac{d\omega}{dt}\right) = -\,g'\sin 2\varepsilon\,\frac{\sin\omega'}{\sin^2\varrho'}$$

ω' being the angle opposite to ω in the triangle FMF'. But it is clear that if we were to take the point F' as origin, the polar axis remaining the same, we should obtain similarly

$$\frac{d}{dt}\left(\sin^2\varrho'\,\frac{d\omega'}{dt}\right) = -\,g\sin 2\varepsilon\,\frac{\sin\omega}{\sin^2\varrho}$$

and this equation, being multiplied by $\sin^2\varrho\,d\omega$ and adding to the preceding one, multiplied by $\sin^2\varrho'\,d\omega'$, furnishes another equation, the two members of which are exact differentials, and whose immediate integral is

$$(2.)\qquad \sin^2\varrho\,\sin^2\varrho'\,\frac{d\omega\,d\omega'}{dt^2} = \sin 2\varepsilon\,(g\cos\omega+g'\cos\omega'+c')$$

c' being an arbitrary number.

Symmetry and especially analogy lead us to select as co-ordinate variables the sum and the difference of the vectors ϱ and ϱ', that is to say, the parameters of the spherical conics which have as their common focus the fixed centers F and F'. For the introduction of these new variables in the most simple manner into the equations (1) and (2), we are led to the consideration of an inscribable plane quadrilateral, whose sides are consecutively a, a', b', b; and in which we will designate the angle (bb') by φ, the angle (ab) by ψ, the diagonal which subtends φ by σ, and that which subtends ψ by δ. Elementary geometry gives

$$\frac{\sigma}{\delta} = \frac{a\,a'+b\,b'}{a\,b+a'\,b'}$$

whence, S being the area of the quadrilateral,

$$\frac{\sigma\sin\varphi}{\delta\sin\psi} = \frac{a\,a'\sin\varphi+b\,b'\sin\varphi}{a\,b\sin\psi+a'\,b'\sin\psi} = \frac{2\,S}{2\,S}$$

and universally

$$\sigma \sin \varphi = \delta \sin \psi.$$

When ψ is supposed equal to a right angle,

$$\sigma \sin \varphi = \delta.$$

Let M and M be the vertices $\widehat{aa'}$ and $\widehat{bb}$, m and m' the vertices $\widehat{ab}$ and $\widehat{a'b}$ the triangle $m\,M\,m'$ gives

$$\delta^2 = b^2 + b'^2 - 2\,b\,b' \cos \phi = a^2 + a'^2 + 2\,a\,a' \cos \varphi,$$

and therefore, since $a^2 = \sigma^2 - b^2$, $a'^2 = \sigma^2 - b^2$,

$$a\,a' + b\,b' = \frac{b^2 + b'^2 - \sigma^2}{\cos \varphi},$$

and as $\sigma^2 = \frac{S^2}{\sin^2 \varphi}$, we have

$$a\,a' = \frac{b\,b'\,(1 + \cos^2 \varphi) - (b^2 + b'^2) \cos \varphi}{\sin^2 \varphi}$$

or, making $b + b' = 2\,p$, $b - b'\,2\,q$,

$$a\,a' = \frac{4\,(p^2 \sin^4 \tfrac{1}{2}\,\varphi - q^2 \cos^4 \tfrac{1}{2}\,\varphi)}{\sin^2 \varphi}.$$

We have also

$$\sigma^2 = \frac{4\,(p^2 \sin^2 \tfrac{1}{2}\,\varphi + q^2 \cos^2 \tfrac{1}{2}\,\varphi)}{\sin^2 \varphi}.$$

A and B being two given quantities, and τ a certain divisor, such that

$$\frac{a\,a'}{\tau^2} = A, \quad \frac{\sigma^2}{\tau^2} = B,$$

divide the two equations given above, member by member, and from the quotients we may immediately deduce

$$(3.) \qquad \frac{p^2}{\cos^2 \frac{1}{2}\,\varphi}\,(B \sin^2 \tfrac{1}{2}\,\varphi - A) = \frac{q^2}{\sin^2 \frac{1}{2}\,\varphi}\,(B \cos^2 \tfrac{1}{2}\,\varphi + A).$$

Now we have merely to diminish the quadrilateral indefinitely, and to take ds for σ, the angle φ will become the angle of the two vectors ϱ and ϱ', and if we make

$$\varrho + \varrho' = 2\,\alpha, \qquad \varrho - \varrho' = 2\,\beta,$$

and put

$$b = d\varrho, \quad b' = d\varrho', \quad a = \sin \varrho d\omega, \quad a' = \sin \varrho' d\omega',$$

whence

$$p^2 = d\alpha^2, \quad q^2 = d\beta^2,$$

the equation (3) and the preceding one will become

$$ds^2 = \frac{d\alpha^2}{\cos^2 \frac{1}{2}\,\phi} + \frac{d\beta^2}{\sin^2 \frac{1}{2}\,\varphi}.$$

$$(4.) \qquad \frac{d\alpha^2}{\cos^2 \frac{1}{2}\,\varphi}\,(B \sin^2 \tfrac{1}{2}\,\varphi - A) = \frac{d\beta^2}{\sin^2 \frac{1}{2}\,\varphi}\,(B \cos^2 \tfrac{1}{2}\,\varphi + A)$$

and to make the equation (4) coincide with the equation deducible from (1) and (2) by the elimination of the time, it will suffice to put

$$A = \frac{\sin 2\,\varepsilon\,(g \cos \omega + g' \cos \omega' + c')}{\sin \varrho \sin \varrho'}$$

$$B = 2\,(g \operatorname{cotang} \varrho + g' \operatorname{cotang} \varrho' + c).$$

The triangle $F\,M\,F'$ gives

$$\cos \omega = \frac{\cos \varrho' - 2 \cos 2\,\varepsilon \cos \varrho}{\sin 2\,\varepsilon \sin \varrho} \qquad \cos \omega' = \frac{\cos \varrho - \cos 2\,\varepsilon \cos \varrho'}{\sin 2\,\varepsilon \sin \varrho'}$$

and by substituting these values in the expression for A, and introducing the variables α and β, we obtain

$$A = \frac{(g' + g) \sin 2\,\alpha\,(\cos 2\,\beta - \cos 2\,\varepsilon) + (g' - g) \sin 2\,\beta\,(\cos 2\,\alpha - \cos 2\,\varepsilon) + c'\,(\cos 2\,\beta - \cos 2\,\alpha)}{2 \sin^2 \varrho \sin^2 \varrho'}.$$

Moreover,

$$B = \frac{(g' + g) \sin 2\,\alpha + (g' + g) \sin 2\,\beta + c\,(\cos 2\,\beta - \cos 2\,\alpha)}{\sin \varrho \sin \varrho'}$$

$$\sin^2 \tfrac{1}{2}\,\varphi = \frac{\cos 2\,\beta - \cos 2\,\varepsilon}{2 \sin \varrho \sin \varrho'}, \quad \cos^2 \tfrac{1}{2}\,\varphi = \frac{\cos 2\,\varepsilon - \cos 2\,\alpha}{2 \sin \varrho \sin \varrho'}.$$

From these several expressions results after reduction

$$B \sin^2 \tfrac{1}{2}\,\varphi - A = \frac{(g' - g) \sin 2\,\beta + c\,(\cos 2\,\beta - \cos 2\,\varepsilon) - c'}{2 \sin^2 \varrho \sin^2 \varrho'}\,(\cos 2\,\beta - \cos 2\,\alpha)$$

$$B \cos^2 \tfrac{1}{2}\,\varphi + A = \frac{(g' + g) \sin 2\,\alpha + c\,(\cos 2\,\varepsilon - \cos 2\,\alpha) + c'}{2 \sin^2 \varrho \sin^2 \varrho'}\,(\cos 2\,\beta - \cos 2\,\alpha)$$

and these different results transform immediately the equation (4) into

$$\frac{d\,\alpha^2}{(\sin^2 \alpha - \sin^2 \varepsilon)\,\{(g' + g) \sin \alpha \cos \alpha + c \sin^2 \alpha + c_1\}} = \frac{d\,\beta^2}{(\sin^2 \varepsilon - \sin^2 \beta)\,\{(g' - g) \sin \beta \cos \beta - c \sin^2 \beta - c_1\}}$$

the equation of the trajectory, when the variables are separated and we have made $c_1 = c - c \sin^2 \varepsilon$.

By putting

$$\operatorname{tang} \alpha = \mu, \qquad \operatorname{tang} \beta = \nu, \qquad \operatorname{tang} \varepsilon = \varpi, \qquad c + c_1 = c' + c \cos^2 \varepsilon = c_2,$$

the equation just found may also be written

$$\frac{d\mu^2}{(\mu^2 - \varpi^2)\,\{c_2\,\mu^2 + (g' + g)\,\mu + c_1\}} = \frac{d\nu^2}{\varpi^2 - \nu^2\,\{- c_2\,\nu^2 + (g' - g)\,\nu - c_1\}}.$$

Under this form we recognize immediately the equation of the plane trajectory which would be described by a body subjected to the action of two others situated at the intersection of the two focal lines of the co-ordinate cones, and of the plane tangent to the sphere at the point where it is met by the common axis of the same cones; the forces emanating from these points of intersection acting in the tangent-plane according to the inverse ratio of the square of the rectilinear distance, with the intensities g and g' at the unit of distance. And the cone which, having this plane trajectory for its base, would at the same time have its vertex at the center of the sphere, would determine upon this surface the spheric trajectory which we have desired to find, supposing always that the initial circumstances are such that the constants c_1 and c_2 have the same value in each case. But in spite of this community of constants, the two bodies supposed at a certain moment upon the same generatrix will separate at the next instant, as is shown by the expression for the time, which it now remains for us to find. For this it suffices to take the equation of living forces which, by the values of ds^2 and $\sin^2 \frac{1}{2}\varphi$, $\cos^2 \frac{1}{2}\varphi$ gives

$$4\,dt^2 = \frac{\dfrac{d\alpha^2}{\sin^2\alpha - \sin^2\varepsilon} + \dfrac{d\beta^2}{\sin^2\varepsilon - \sin^2\beta}}{(g'+g)\sin\alpha\cos\alpha + (g'-g)\sin\beta\cos\beta + c\,(\sin^2\alpha - \sin^2\beta)}\,(\sin^2\alpha - \sin^2\beta)^2\,.$$

But from the equation of the trajectory in terms of α and β we deduce, by the addition of the numerators and the denominators, precisely the first factor of the second member of the preceding equation, and as this expression when deduced ought to be equivalent to one of the members of the equation which has furnished it, we conclude

$$2\,dt = \sin^2\alpha - \sin^2\beta\,\frac{d\alpha}{\sqrt{\sin^2\alpha - \sin^2\varepsilon}\;\sqrt{(g'+g)\sin\alpha\cos\alpha + c\sin^2\alpha + c_1}}\,,$$

or, having regard to the equation of the trajectory

$$2\,dt = \frac{\sin^2\alpha\,d\alpha}{\sqrt{\sin^2\alpha - \sin^2\varepsilon}\;\sqrt{(g'+g)\sin\alpha\cos\alpha + c\sin^2\alpha + c_1}} - \frac{\sin^2\beta\,d\beta}{\sqrt{\sin^2\varepsilon - \sin^2\beta}\;\sqrt{(g'-g)\sin\beta\cos\beta - c\sin^2\beta - c_1}}\,,$$

which may finally be written

$$2\cos\varepsilon\,dt = \frac{\mu^2}{1+\mu^2}\,\frac{d\mu}{\sqrt{\mu^2+\iota^2}\;\sqrt{(g'+g)\,\mu + c^2\,\mu^2 + c_1}} - \frac{r^2}{1+r^2}\,\frac{d\nu}{\sqrt{\iota^2 - r^2}\;\sqrt{(g'-g)\,\nu - c_2\,\nu^2 - c_1}}\,,$$

an expression which does not coincide with that of the plane problem, and which would naturally attain this coincidence when the radius of the sphere is supposed to increase indefinitely, or, if it be preferred, when an infinitesimal relation is established between the spheric dimensions and this radius. As the present problem has been, for the case of the plane, the object of profound study by numerous geometers, and especially by LEGENDRE, it does not seem to me necessary to enter here into the mechanical and analytical details which the various particular cases of motion might require. I will merely allude to the case in which, one of the forces being zero, the body will describe a spherical conic, according to what has been seen in the preceding sections, from which certain relations may be deduced for the comparison of elliptic functions.

FROM A LETTER OF MR. LE VERRIER TO THE EDITOR.

Imperial Observatory, Paris, January 20, 1855.

ON Sunday, January 14, at $17^{h.}\,30^{m.}$, Mr. DIEN, an *attaché* of the Imperial Observatory, remarked a nebulosity situated near to and southward of *γ Scorpii*. The clouds permitted only the following estimate of its position.

$$\alpha = 15^{h.}\,2^{m.}\,;\ \delta = -\,27°\,30'.$$

The state of the sky permitted no observation on the 15th or 16th.

On the 17th we obtained

M. T. Paris. h. m. s.	☄ — * α m. s.	☄ — * δ	Comp. Star.	No. of Comp.
18 19 57.3	+0 56.00		*a* (8.9)	1
18 25 50.8	—1 52.37		*b* (7)	1
18 26 42.2		—4′ 15″.9	*b* (7)	1

On the 18th we found

M. T. Paris. h. m. s.	☄ — * α m. s.	☄ — * δ	Comp.-Star.	No. of Comp.
17 43 45.9	—2 51.21		*c* (8)	4
17 51 6.9		+0′ 52″.2	*c* (8)	5

The comet, which on the 17th was very faint, could only be seen by means of a new instrument, which had been so deranged by the intense cold that the direct observation of the stars *a* and *b* was impossible.

The approximate position for the star *c*, of the 18th, was

$$\alpha = 15^{h.}\,16^{m.}\,50^{s.}\,;\ \delta = -27°\,34'.$$

The comet presented many centers of light, and no tail was visible.

U. J. LE VERRIER.

Dr. Peters announces the discovery of this comet by Mr. Winnecke in Berlin almost at the same time as by Mr. Dien. Mr. Bruhns, at Berlin, observed the comet as follows: —

1855.	M. T. Berlin. h. m. s.	☄ α ° ′ ″	☄ δ ° ′ ″
Jan. 15	18 4 16.2	226 5 15.4	—27 15 5.3
17	17 32 52.1	227 41 23.6	—27 27 50.3
18	17 58 19.6	228 30 17.9	—27 33 38.3

From these observations he has computed the approximate ephemeris given below.

G.

Ephemeris for Mean Berlin Noon.

Date, 1855.	☄ α h. m. s.	☄ δ ° ′	Log. △
Feb. 1	15 53 57	—28 19.3	0.19553
2	56 45	20.5	
3	15 59 31	—28 21.5	
Feb. 4	16 2 16	—28 22.2	
5	5 0	22.5	0.19494
6	7 42	22.6	
7	10 21	22.6	
8	12 57	22.3	
9	15 30	21.6	0.19423
10	18 1	20.7	
11	20 31	19.6	
12	22 59	18.2	
13	25 26	16.5	0.19338
14	27 50	14.6	
15	30 11	12.6	
16	32 30	10.2	
17	16 34 46	—28 7.6	0.19239

OBSERVATIONS OF EGERIA AND EUPHROSYNE,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By JAMES FERGUSON.

[Communicated by Lieutenant Maury. — Corrected for refraction.]

EGERIA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑬ — *		⑬'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1854, Sept. 1	11 3 24.1	6	B. A. C. 598	+2 16.28	—10 36.80	1 52 52.55	—2 56 42.06
2	11 27 29.1	5	"	+1 58.83	—11 47.76	1 52 35.12	—2 57 53.26
	12 40 40.9	7	"	+1 58.27	—11 48.67	1 52 34.55	—2 57 54.17
	13 34 9.6	3	"	+1 57.36	—11 51.48	1 52 33.65	—2 57 56 99
6	16 20 11.4	6	"	+0 30.69	—17 18.51	1 51 7.08	—3 3 23.75
16	11 57 15.2	4	Weisse I. 790	+1 32.76	+ 2 14.35	1 45 46.95	—3 19 7.40
17	10 58 48.9	6	"	+0 53.75	+ 0 36.57	1 45 7.95	—3 20 45.12
21	10 58 55.9	5	"	—2 5.10	— 6 18.71	1 42 9.16	—3 27 39.79
Oct. 7	10 44 17.7	6	Rümker 331	+2 24.18	+ 3 28.28	1 27 9.34	—3 49 12.29
8	8 53 22.9	6	"	+1 26.08	+ 2 51.78	1 26 11.28	—3 49 48.97
15	10 2 19.0	6	Weisse I. 280	+1 12.11	—15 17.87	1 18 38.74	—3 51 31.79
17	10 34 50.1	8	" 280	—0 57.72	—14 39.74	1 16 28.85	—3 50 53.74
20	8 17 15.7	10	" 202	+0 10.91	+11 40.23	1 13 24.22	—3 48 54.76
Dec. 14	7 46 43.3	5	Weisse O. 806	+0 41.36	—17 35.90	0 46 53.45	+0 49 40.55
	8 44 5.9	4	" 806	+0 42.10	—17 17.24	0 46 51.19	+0 49 58.71
20	8 39 46.6	5	" 893	—2 49.72	— 9 48.67	0 48 44.10	+1 42 40.15
		5	" 918	—3 52.85	— 8 18.35	0 18 (45).14	+1 42 39.22
21	8 49 45.3	5	" 893	—2 25.47	— 0 41.52	0 49 8.35	+1 51 47.23
		5	" 918	—3 29.14	— 0 51.11	0 49 8.85	+1 51 48.61
(1) 1855, Jan. 10	9 22 19.3	2	B. A. C. 328	+0 36.12	+14 31.98	1 1 29.05	+5 9 20.49
(1) 12	8 37 31.0	4	(1)	—0 30.39	+16 25.57	1 3 6.79	+5 27 40.29
16	8 37 4.0	10	B. A. C. 373	—0 31.99	— 3 53.41	1 6 37.23	+6 9 43.01
18	8 9 2.6	5	" 373	+1 18.13	+17 5.32	1 8 37.24	+6 30 41.39
19	7 41 31.9	8	" 368	+3 14.82	— 7 9.61	1 9 23.50	+6 41 14.40
Feb. 3	8 10 3.5	7	Weisse I. 410	+1 6.38	+10 17.70	1 25 20.90	+9 24 38.23

(1) Observations not satisfactory.

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 598	7	1 52 22.24	—2 47 34.73	Wash. Obs. (α 4 Transit, δ 5 Mural).
Weisse I. 790	8	1 43 59.63	—3 22 52.86	α Weisse's Catalogue, δ 2 Mural.
Rümker 331	9	1 24 30.30	—3 54 14.42	Rümker's Catalogue.
Weisse I. 280	7	1 17 11.64	—3 37 48.34	Weisse's Catalogue.
" 202	7	1 12 57.99	—4 2 8.64	α Weisse's Catalogue, δ 2 Mural.
Weisse O. 806	7	0 45 57.27	+1 5 41.23	" " δ 1 Mural.
" 893	9	0 51 19.00	+1 50 54.78	" " "
" 918	9	0 52 23.16	+1 49 21.37	" " "

Mean Places for 1860.0.

*	Mag.	α	δ	Authority.
B. A. C. 328	5	1 1 9.64	+4 54 28.94	British Association Catalogue.
(1)	12	1 3 53.68	+5 12 55.32	Wash. Equatorial from 328, 4 comps.
B. A. C. 368	6	1 6 25.12	+6 50 2.99	B. A. Cat. and Greenwich 12 Y. Cat.
" 373	5.6	1 7 25.61	+6 15 15.63	British Association Catalogue.
Weisse I. 410	8	1 24 31.53	+9 15 56.95	Weisse's Catalogue.

EUPHROSYNE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉛ — *		㉛s' apparent	
				Δ α	Δ δ	δ	α
	h. m. s.			m. s.	′ ″	° ′ ″	h. m. s.
1854, Sept. 2	10 59 2.5	4	B. A. C. 598	+1 37.02	—11 6.58	1 52 13.51	—2 57 12.07
	12 1 2.1	5	"	+1 35.68	—11 3.36	1 52 12.17	2 57 8.85
	13 31 6.6	3	"	+1 34.40	—10 57.49	1 52 10.89	2 57 2.98
6	15 38 49.5	12	"	—0 10.24	— 7 21.66	1 50 26.35	2 53 26.89
	16 30 54.4	3	"	—0 11.56	— 7 18.34	1 50 25.03	2 53 23.57
10	16 19 16.5	7	"	—2 18.28	— 4 8.97	1 48 18.68	2 50 13.92
12	10 21 26.1	2	Weisse I. 821	+1 24.56	+ 4 18.57	1 47 14.17	2 48 53.32
		2	B. A. C. 598	—3 21.26	— 2 47.44	1 47 15.42	2 48 52.30
14	10 6 14.1	8	Weisse I. 808	+0 47.06	— 2 40.80	1 45 57.88	2 47 25.39
	10 35 45.3	8	" 821	+0 7.12	+ 5 48.59	1 45 56.78	2 47 23.21
16	10 47 36.1	8	" 808	—0 37.40	— 1 10.21	1 44 33.48	2 45 54.65
		8	" 821	—1 16.05	+ 7 16.99	1 44 33.68	2 45 54.71
17	10 28 42.7	6	" 773	+0 35.95	+ 1 50.70	1 43 51.19	2 45 6.68
		6	" 808	—1 20.20	— 0 24.05	1 43 50.69	2 45 8.42
21	10 18 30.2	10	" 773	—2 31.75	+ 4 54.66	1 40 43 53	2 42 3.60
22	10 3 50.6	5	" 773	—3 21.02	+ 5 41.71	1 39 54.30	2 41 16.30
23	9 59 3.5	14	Lalande 3237	+0 35.31	— 1 3.23	1 39 2.28	2 40 17.47
24	9 21 47.7	10	"	—0 15.73	— 0 9.85	1 38 11.25	2 39 24.07
26	9 50 10.8	6	"	—2 5.38	+ 1 43.33	1 36 21.63	2 37 30.84
29	9 42 58.0	4	Weisse I. 582	+0 27.79	—14 1.43	1 33 31.59	2 34 17.32
30	9 49 37.1	4	" 582	—0 31.23	—12 50.92	1 32 32.62	2 33 6.83
Oct. 5	9 10 12.6	10	" 450	+1 14.62	+10 22.55	1 27 28.46	2 26 17.72
7	9 16 55.9	5	" 432	+0 1.79	+ 0 55.84	1 25 21.33	2 23 3.84
		5	" 441	—0 24.05	+ 9 12.53	1 25 21.65	2 23 1.51
		5	" 450	—0 52.39	+13 39.51	1 25 21.42	2 23 0.78
8	8 19 25.0	10	" 432	—0 59.58	+ 2 36.31	1 24 19.98	2 21 23.38
15	9 11 17.6	10	" 206	+3 9.72	— 2 21.33	1 16 38.65	2 6 42.22
17	9 50 49.3	12	" 206	+0 56.06	+ 2 53.24	1 14 24.99	2 1 27.50
19	9 26 41.9	12	" 206	—1 13.85	+ 8 17.48	1 12 15.08	1 56 3.52
21	9 24 21.4	12	B. A. C. 374	+2 39.28	— 5 8.46	1 10 4.47	1 50 12.93
22	8 45 53.4	6	"	+1 36.81	— 2 4.59	1 9 2.01	1 47 9.09
23	9 27 9.8	12	"	+0 30.38	+ 1 15.82	1 7 55.58	1 43 49.42
24	9 32 52.2	10	"	—0 32.31	+ 4 39.97	1 6 52.89	1 40 24.60
25	9 29 5.2	10	"	—1 35.85	+ 8 9.16	1 5 49.36	1 36 55.45
30	8 25 27.7	2	Weisse O.1033	+1 56.53	—15 14.54	1 0 46.25	1 17 49.91
31	9 35 58.1	12	"	+0 55.48	—10 50.85	0 59 45.19	1 13 26.26
Nov. 2	8 40 28.0	10	"	—0 55.83	— 2 12.89	0 57 53.87	1 4 48.38
4	10 6 50.9	5	"	—2 48.87	+ 7 23.16	0 56 0.83	0 55 12.42
5	8 30 4.2	7	"	—3 38.22	+11 51.39	0 55 11.46	—0 50 44.24

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉛ — *		㉛'s apparent	
				Δα	Δδ	α	δ
	h. m. s.			m. s.	′ ″	h. m.	° ′ ″
1854, Dec. 13	6 46 18.7	11	Weisse O. 711	—1 17.77	+12 3.37	0 39 35.37	+3 33 3.62
	8 39 31.0	4	"	—1 17.47	+12 40.93	0 39 35.68	3 33 41.11
14	6 21 16.7	7	(3)	+0 13.12	+ 7 57.24	0 39 41.00	3 41 35.91
	7 6 49.7	3	"	+0 14.22	+ 8 16.05	0 39 41.80	3 41 51.72
18	8 1 34.6	7	Weisse O. 647	+2 42.28	— 5 6.59	0 40 17.79	4 18 4.57
20	7 38 46.4	13	B. A. C. 221	—0 0.92	+ 4 32.08	0 40 44.72	4 36 38.30
21	7 29 10.9	11	"	+0 14.14	+13 33.65	0 40 59.81	4 45 39.84
1855, Jan. 1	7 11 3.7	10	Weisse O. 808	—0 57.33	+ 2 37.73	0 45 20.54	6 31 51.42
10	7 10 22.3	10	" 925	—2 26.86	+ 8 47.28	0 50 42.71	8 3 52.78
	7 4 9.1	9	" 931	—2 48.32	+ 4 29.23	0 50 42.47	8 3 51.47
	7 32 40.4	6	B. A. C. 286	—4 13.01	+ 1 36.67	0 50 42.93	8 3 58.69
12	6 51 22.3	10	Weisse O. 965	—3 1.80	+ 3 43.63	0 52 6.17	+8 21 49.79

Adopted Mean Places, 1850.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 598	7	1 50 22.240	—2 47 31.73	Washington Obs., 4 T., 5 M.
Weisse I. 821	9	1 45 35.166	—2 54 42.52	" 1 T., 3 M.
" 808	9	1 44 56.291	—2 46 15.28	" 1 T., 3 M.
" 773	8.9	1 43 0.625	—2 48 29.60	" 4 T., 3 M.
Lalande 3237	8	1 38 12.270	—2 40 46.30	" 3 T., 3 M.
Weisse I. 582	9	1 32 48.978	—2 21 48.72	" 3 T., 2 M.
" 450	9	1 25 58.889	—2 38 13.91	" 3 T., 2 M.
" 441	9	1 25 30.804	—2 33 47.76	" 2 T., 2 M.
" 432	9	1 25 4.656	—2 25 33.57	" 1 T., 3 M.
" 206	8	1 13 13.844	—2 5 55.75	" 3 T., 2 M.
B. A. C. 374	6	1 7 10.149	—1 46 38.76	" 3 T., 5 M.
Weisse O. 1033	9	0 58 34.628	—1 4 11.06	" 2 T., 3 M.
" 711	9	0 40 38.32	+3 19 24.61	α Weisse's Catalogue; δ 1 M.
(3)	10	0 39 12.77	+3 32 2.92	Equatorial from 711, 4 comparisons.
Weisse O. 647	8	0 37 20.74	+4 21 35.30	α Weisse's Catalogue; δ 2 M.
B. A. C. 221	6	0 40 30.85	+4 30 30.62	Mean, Rümker, Wash. M., and B.A.C.
Weisse O. 808	9	0 46 3.31	+6 27 38.15	Mean, Rümker and Weisse.
		Mean Places for 1860.0.		
Weisse O. 925	9	0 53 25.97	+7 56 46.46	Weisse's Catalogue.
" 931	9	0 53 47.19	+8 1 3.13	"
B. A. C. 286	7	0 55 12.31	+8 4 2.71	British Association Catalogue.
Weisse O. 965	7	0 55 21.39	+8 22 46.41	Weisse's Catalogue.

The stars, in the list of mean places, marked T. M. in the last column, are determined by the number of observations with the Transit by Mr. FERGUSON, and Mural by Professor YARNALL, which are prefixed to their letters.

Several of the observations have been before published in the *Astronomical Journal* and *Astronomische Nachrichten*, but the places of the stars have been better determined since, and the computations revised.

It is probable that both *Egeria* and *Euphrosyne* will be seen in March.

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THE

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LETTER FROM THOMAS MACLEAR, ESQ. TO THE EDITOR.

Royal Observatory, Cape of Good Hope, 1854, *November* 17.

I HAVE just detected some errors in the reduction of the observations made at this place on Schweizer's Comet, which were published in the *Monthly Notice* No. 1, Vol. XX., of the Royal Astronomical Society. The revised copy sent to you herewith, I hope you will receive in time for any computation of the orbit that may be undertaken in the United States. Professor HUBBARD is very industrious in this department.

The mean places of the stars compared with the comet, for 1854, January 1, are given by Professor CHALLIS in the Royal Astronomical Society's *Notice* No. 8, excepting that of No. 21, which I derived a few days ago by micrometric measurement from No. 20, as follows: —

1854, Jan. 1. Star 21, R.A. $= 7^{h.}\ 11^{m.}\ 19^{s.}.33$

N. P. D. $= 103°\ 26'\ 24''.55$.

T. MACLEAR.

OBSERVATIONS OF THE SECOND COMET OF 1853,

MADE AT THE ROYAL OBSERVATORY, CAPE OF GOOD HOPE.

By THOMAS MACLEAR, Esq.

[Corrected for refraction only.]

	M. T. Cape G. H.	$\Delta\ \alpha$	No. Obs.	Δ N. P. D.	No. Obs.	* No.
1853.	h. m. s.	m. s.		′ ″		
May 1	7 46 28.10			+ 2 50.24	2	1
	7 56 37.29	—1 46.532	2			1
	8 6 17.36			+ 3 38.17	2	1
	8 26 37.32			+ 4 25.86	5	1
	8 37 17.28	—0 34.479	1			1
3	7 19 49.87			+ 5 12.82	3	2
	7 42 23.62	—1 12.658	4			2
	7 42 23.62	—1 34.739	4			3
	7 42 23.62	—1 53.530	4			4
	7 56 28.52			+ 5 25.34	3	2
	8 10 29.46	—0 50.447	3			2
	9 11 36.35	—0 1.623	8			2
	9 18 32.71			+ 5 41.45	1	2
4	6 35 11.59			— 4 56.02	2	5
	6 57 18.62	+0 34.348	9			5
	6 57 18.62	—0 17.970	9			6
May 4	7 14 42.60			— 3 19.55	2	6
	7 22 51.73	—0 3.370	9			6
	7 35 59.60			— 3 20.31	2	6
	8 8 11.72	+0 25.340	5			6
	8 30 21.54			— 3 19.85	3	6
	8 44 49.83	+0 41.486	3			6
	8 10 53.45	—1 22.002	3			7
	8 30 21.54			— 1 4.42	3	7
	8 50 28.63	—0 58.841	6			7
	9 13 5.16			— 1 7.67	2	7
5	7 0 27.44			+11 28.42	1	8
	7 37 17.49	—7 29.912	1			8
7	7 3 43.40	+1 14.379	4			9
	7 19 37.18			—10 13.21	2	9
	7 36 1.49	+1 22.408	3			9
	8 3 37.29			—10 23.67	3	9

Clouded on the 2d.

May 5. Owing to clouds, these observations only could be obtained.

" 7. Angle of position of comet's tail 118° 40′. No. 10 is in the comet's tail.

	M. T. Cape G. H.	Δ α	No. Obs.	Δ N. P. D.	No. Obs.	✻ No.
1853	h. m s.	m. s.		′ ″		
May 7	9 3 57.54			−10 31.27	2	9
	9 11 16.84	+1 47.781	1			9
	7 3 43.40	−0 46.079	4			10
	7 25 34.21			− 7 36.70	2	10
	7 36 1.49	−0 37.838	3			10
	8 35 1.80			− 7 52.92	2	10
	9 11 16.84	−0 12.661	1			10
8	6 23 36.26	−0 34.350	4			11
	6 44 36.46			− 1 28.88	2	11
	6 23 36.26	−1 1.502	4			12
	6 50 2.67			+ 3 59.82	2	12
	6 23 36.26	−2 20.278	4			13
	7 0 22.20			+10 54.81	3	13
9	7 2 3.47	+2 31.153	2			13
	7 30 53.78	+2 36.305	1			13
	7 43 20.78			+ 6 47.17	3	13
	8 2 31.62	+2 42.029	5			13
	8 19 33.00			+ 6 39.63	2	13
10	7 11 44.27			− 3 6.40	2	14
	7 30 39.76	−0 27.602	1			14
11	6 36 25.27	+0 44.368	3			15
	7 0 34.48			+ 5 37.06	4	15
	7 21 27.38	+0 50.129	4			15
	8 12 59.09			+ 5 20.65	4	15
	8 32 5.06	+0 58.440	4			15
	6 36 25.27	−1 37.933	3			16
	7 0 34.48			+ 1 2.07	4	16
	7 21 27.38	−1 32.201	4			16
	8 12 59.09			+ 0 45.13	4	16
	8 32 5.06	−1 23.953	4			16
12	6 41 44.35			+ 1 20.44	6	17
	6 54 57.74	−0 1.515	8			17
	7 2 55.05	−0 0.727	9			17
	7 15 7.60			+ 1 14.82	9	17
	7 36 9.97	+0 2.656	4			17
	8 10 38.13			+ 1 5.85	5	17
	8 19 36.27	+0 7.158	5			17
14	7 27 56.82			− 5 52.53	3	17
	8 4 32.88	+4 28.769	5			17
	8 42 50.40			− 6 6.18	5	17
15	6 32 58.31			+ 3 34.95	5	18
	6 49 34.79	−0 37.701	5			18
	7 7 42.58	−0 36.625	5			18
	7 24 52.76			+ 3 27.48	5	18
	7 40 2.46	−0 34.625	5			18
	7 49 22.93			+ 3 22.72	5	18
	8 0 31.68	−0 33.223	5			18
	8 11 40.64			+ 3 20.33	5	18
16	6 20 43.76			+ 7 42.41	5	19
	6 32 35.81	−0 27.532	5			19
	6 40 49.26			+ 7 38.85	5	19
1853.	h. m. s.	m. s.		′ ″		
May 16	6 53 34.76	−0 26.166	5			19
	7 3 28.35			+ 7 37.75	5	19
	7 14 24.55	−0 24.868	5			19
	7 21 15.63			+ 7 33.79	5	19
	7 37 17.40	−0 23.256	5			19
	7 49 10.05			+ 7 28.26	5	19
	7 57 44.84	−0 22.118	5			19
	8 21 20.18			+ 7 23.12	5	19
17	6 15 6.14	−0 17.635	5			20
	6 16 0.00	−0 22.284	5			21
	6 58 51.77			− 7 56.53	5	20
	7 5 4.55			+ 3 26.32	5	21
	7 16 43.34	−0 14.416	5			20
	7 18 12.00	−0 19.047	5			21
	7 28 54.65			− 8 0.01	5	20
	7 34 51.87			+ 3 26.49	5	21
	7 47 36.38	−0 12.801	5			20
	7 48 38.21	−0 17.328	5			21
	8 4 19.63			− 8 0.36	5	20
	8 9 58.11			+ 3 17.34	5	21
20	6 42 20.46	−0 13.130	5			22
	6 49 23.50			− 0 48.62	5	22
	6 55 1.77	−0 12.631	5			22
	7 2 55.48			− 0 51.64	5	22
	7 8 59.68	−0 11.939	5			22
	7 15 43.57			− 0 50.25	5	22
	7 21 17.66	−0 11.499	5			22
21	6 41 26.83			+ 6 3.15	5	23
	6 49 47.26	+0 15.169	5			23
	6 55 44.28			+ 6 3.05	5	23
	7 2 29.57	+0 15.464	5			23
	7 9 28.82			+ 6 1.23	5	23
23	6 35 26.93			+ 7 51.42	5	24
	6 48 36.57	−0 2.862	5			24
	7 0 21.44	−0 2.726	5			24
	7 9 41.51	−0 2.275	5			24
	7 18 44.82			+ 7 41.29	5	24
28	6 27 55.21			+ 4 55.45	5	25
	6 45 59.48	−0 31.904	5			25
	6 56 48.34	−0 31.935	5			25
	7 6 1.61			+ 4 51.99	5	25
29	6 13 20.56	−0 6.919	5			25
	6 20 29.69			+ 2 32.25	5	25
	6 29 17.02	−0 6.573	5			25
	6 35 10.81			+ 2 30.35	5	25
	6 40 52.64	−0 6.273	5			25
31	6 24 32.60	+0 38.938	5			25
	6 31 0.12			− 2 5.16	5	25
	6 37 46.37	+0 38.917	5			25
	6 46 57.97			− 2 9.65	5	25
	6 54 6.78	+0 38.865	5			25

May 7. Angle of position of comet's tail 121° 30′. Nucleus remarkably bright.
" 10. Clouded after these observations.
" 11. Angle of position of comet's tail 115° 40′. Nucleus less bright; halo round the head more diffused.

" 12. Angle of position of comet's tail 117° 30′
" 14. " " " " 118 0 Clouds.
" 15. " " " " 117 35
" 17. " " " " 118 45
" 20. The comet is faint, partly owing to moonlight. The tail barely distinguishable.
" 23. Thin clouds. The comet is very indistinct.
" 29. The comet is very faint.

	M. T. Cape G. H.	Δα	No. Obs.	Δ N. P. D.	No. Obs.	* No.
1853.	h. m. s.	m. s.		′ ″		
June 1	6 27 12.98			+10 1.96	5	26
	6 34 57.26	—0 50.387	5			26
	6 41 52.68			+ 9 58.95	5	26
	6 50 17.87	—0 49.796	5			26
	7 14 34.44	—0 48.083	3			26
	7 14 34.44	+1 0.237	3			25
	7 24 49.65			— 4 23.62	5	25
2	6 27 25.54	+1 18.965	3			25
	6 45 16.64			— 6 26.94	4	25
	7 1 22.02	+1 19.253	2			25
	6 27 25.54	—1 24.261	3			27
	6 45 16.64			— 2 53.07	4	27
	7 1 22.02	—1 23.896	2			27
3	6 36 53.39			+ 5 54.40	5	26
	6 45 8.39	—0 11.989	5			26
	6 52 20.58			+ 5 53.80	5	26
4	7 7 22.67			+ 3 53.75	1	26
	7 13 12.69	+0 5.810	2			26
	7 25 19.64			+ 3 47.42	2	26
5	6 34 48.27			+ 2 4.91	3	26
1853	h. m. s.	m. s.		′ ″		
June 5	6 45 21.34	+0 22.608	5			26
	6 55 12.79			+ 2 4.20	3	26
7	6 35 58.61			— 1 22.38	3	26
	6 47 3.93	+0 54.498	10			26
	6 58 43.86			— 1 24.30	5	26
	7 16 36.13	+0 54.550	10			26
	7 31 40.34			— 1 26.34	2	26
8	6 49 9.52	+1 8.199	5			26
	7 7 54.37			— 2 59.49	10	26
	7 26 44.26	+1 9.505	3			26
9	6 23 37.43			— 4 22.13	5	26
	6 38 11.42	+1 23.619	7			26
	6 56 13.48			— 4 23.55	5	26
10	6 23 48.76			— 5 47.12	5	26
	6 39 39.45	+1 38.681	5			26
	6 54 45.86			— 5 48.28	5	26
11	6 34 14.35			+ 4 51.73	5	28
	6 45 47.37	—0 23.449	5			28
	6 55 0.64			+ 4 50.24	5	28

June 1. The measurements diminish in precision, owing to the faintness of the comet.
" 3. The comet is very faint.
" 4. Generally clouded. These observations only could be obtained.
" 10. The moonlight is now diminishing the visibility of the comet.

For completeness, I append Professor Challis's list of mean places of the comparison-stars used by Mr. Maclear in the preceding observations. The places were determined by Professor Challis from meridian observations, and are reprinted from the *Monthly Notices* of the Royal Astronomical Society, Vol. XIV. p. 217.

G.

MEAN PLACES FOR 1854, JAN. 1, OF MR. MACLEAR'S COMPARISON-STARS FOR COMET 1853, II.

Ref No.	Name.	α	No. Obs.	δ	No. Obs.
		h. m. s.		° ′ ″	
1		4 59 52.32	2	—13 19 20.63	3
2	H. C. 11551	5 57 33.44	2	14 4 57.36	5
3		5 57 55.39	3	14 1 38.67	3
4		5 58 14.21	2	14 6 49.58	3
5		6 11 56.91	3	14 18 19.60	3
6		6 12 48.78	2	14 16 43.45	3
7		6 14 35.97	3	14 14 27.82	4
8	H. C. 12825	6 32 36.39	3	14 1 5.18	4
9	B. A. C. 2221	6 40 11.56	3	14 16 22.08	3
10		6 42 11.88	3	14 13 44.49	3
11		6 47 39.40	3	14 3 48.17	3
12	H. C. 13392	6 48 6.38	3	13 58 24.34	2
13	μ Canis Majoris	6 49 25.22	3	13 51 28.46	3
14		6 56 23.24	2	—13 57 31.47	3
15		6 58 19.26	3	—13 45 4.95	3
16	H. C. 13848	7 0 41.58	3	13 49 38.05	3
17		7 1 53.54	3	13 45 37.84	3
18		7 8 41.26	3	13 32 54.11	4
19		7 10 3.02	2	13 25 28.99	3
20	H. C. 14228	7 11 14.87	3	13 27 47.73	2
21		7 11 19.93	2		
22		7 14 26.97	2	13 21 28.21	3
23		7 14 51.30	2	13 11 37.77	3
24		7 16 38.61	3	13 4 18.22	3
25		7 19 49.56	3	12 53 59.92	3
26		7 21 39.14	3	12 39 39.14	3
27		7 22 32.77	3	12 50 27.85	3
28		7 23 54.12	2	—12 27 48.78	3

ELEMENTS OF THALIA, AND ELEMENTS OF MELPOMENE, WITH AN EPHEMERIS.

By ERNEST SCHUBERT.

[Communicated by Commander C. H. Davis, U. S. N., Superintendent of American Ephemeris and Nautical Almanac.]

ELEMENTS OF THALIA, ㉓.

From the following normal places referred to the mean equinox 1854, Jan. 0, M. T. Berlin,

M. T. Berlin.	α	δ
1852 Dec. 24.5	46° 48′ 52″.76	+17° 25′ 5″.89
1853 April 26.5	87 31 36.33	+29 7 56.04
1854 May 17.5	228 48 55.88	—13 32 23.86

I have deduced the elements of *Thalia* as follows:—

Epoch and Mean Equinox 1854.0, M. T. Washington.

M	50° 28′ 24″.8
π	123 12 53.4
☊	67 55 59.6
i	10 13 56.3
φ	13 37 31.1
Log a	0.4193643
Log μ	2.9209601
μ	833″.6046

ELEMENTS OF MELPOMENE, ⑱.

The elements of *Melpomene* deduced from normal places

M. T. Berlin.	α	δ
1852 July 1.0	271° 34′ 27″.44	— 8° 35′ 16″.55
1853 Jan. 1.0	322 27 57.18	—16 2 43.43
1853 Oct. 26.0	129 1 8.90	+10 8 8.10

are,—

Epoch and Mean Equinox 1853.0, M. T. Washington.

M	336° 29′ 57″.6
π	15 14 38.2
☊	149 59 34.4
i	10 9 9.3
φ	12 30 49.8
Log a	0.3607445
Log μ	3.0088899
μ	1020″.681

These elements give the following ephemeris, in computing which regard has been had to the action of *Jupiter* and *Saturn*.

EPHEMERIS OF MELPOMENE FOR 1855.

Mean Midnight, Washington.

1855.	⑱ α	⑱ δ	Log △	Log r
	h. m. s.	° ′ ″		
March 15	15 16 14.51	—5 41 63.0	0.313129	0.441094
16	16 12.05	36 13.0		
17	16 8.01	30 26.8	0.308221	
18	16 2.39	24 34.4		
19	15 55.20	18 35.9	0.303390	0.440638
20	15 46.43	12 31.5		
21	15 36.10	6 21.3	0.298646	
22	15 24.20	5 0 5.6		
23	15 10.73	4 53 44.5	0.293999	0.440161
24	14 55.69	47 18.3		
25	14 39.09	40 47.2	0.289461	
26	14 20.93	34 11.4		
27	14 1.21	27 31.0	0.285045	0.439662
28	13 39.95	20 46.3		
29	13 17.15	13 37.5	0.280769	
30	12 52.83	7 4.7		
31	12 27.01	4 0 8.4	0.276637	0.439143
April 1	11 59.69	3 53 9.1		
2	11 30.89	46 6.8	0.272647	
3	11 0.63	39 1.7		
4	10 28.92	31 51.1	0.268816	0.438503
5	15 9 55.78	—3 24 41.1		
April 6	15 9 21.24	—3 17 32.2	0.265162	
7	8 45.30	10 18.7		
8	8 8.00	3 3 4.0	0.261700	0.438043
9	7 29.35	2 55 48.3		
10	6 49.40	48 32.0	0.258441	
11	6 8.18	41 15.4		
12	5 25.72	33 59.0	0.255395	0.437461
13	4 42.06	26 43.2		
14	3 57.25	19 28.3	0.252573	
15	3 11.33	12 14.8		
16	2 24.35	2 5 3.1	0.249984	0.436858
17	1 36.35	1 57 53.6		
18	15 0 47.36	50 46.7	0.247640	
19	14 59 57.45	43 42.8		
20	59 6.67	36 42.3	0.245541	0.436235
21	58 15.07	29 45.6		
22	57 22.70	22 53.1	0.243702	
23	56 29.62	16 5.3		
24	55 35.89	9 22.5	0.242126	0.435590
25	54 41.57	1 2 45.1		
26	53 46.71	0 56 13.5	0.240818	
27	14 52 51.37	—0 49 48.1		

1855.		⑱ α	⑱ δ	Log △	Log *r*	1855.		⑱ α	⑱ δ	Log △	Log *r*
		h. m. s.	° ′ ″					h m. s.	° ′ ″		
April	28	14 51 55.61	—0 43 29.2	0.239779	0.434924	May	17	14 31 13.66	+0 48 39.9		
	29	50 59.48	37 17.1				18	33 21.83	51 44.0	0.244259	0.431279
	30	50 3.03	31 12.3	0.239013			19	32 30.80	54 35.9		
May	1	49 6.33	25 15.1				20	31 40.60	57 15.6	0.246118	
	2	48 9.43	19 25.8	0.238522	0.434238		21	30 51.30	0 59 43.0		
	3	47 12.41	13 44.9				22	30 2.96	1 1 58.1	0.248206	0.430187
	4	46 15.32	8 12.6	0.238301			23	29 15.62	4 0.8		
	5	45 18.22	—0 2 49.1				24	28 29.33	5 51.1	0.250503	
	6	44 21.18	+0 2 25.2	0.238360	0.433530		25	27 44.11	7 29.1		
	7	43 24.25	7 30.0				26	26 59.99	8 54.8	0.253002	0.429672
	8	42 27.48	12 25.3	0.238689			27	26 17.01	10 8.0		
	9	41 30.93	17 10.6				28	25 35.19	11 8.7	0.255693	
	10	40 34.65	21 45.4	0.239287	0.432801		29	24 54.57	11 57.2		
	11	39 38.70	26 9.5				30	24 15.18	12 33.6	0.258566	0.428836
	12	38 43.16	30 22.7	0.240150			31	23 37.04	12 57.8		
	13	37 48.08	34 25.1			June	1	23 0.17	13 9.8	0.261610	
	14	36 53.51	38 16.3	0.241270	0.432050		2	22 24.60	13 9.7		
	15	35 59.55	41 55.9				3	14 21 50.35	+1 12 57.6	0.264816	0.427980
	16	14 35 6.25	+0 45 23.8	0.242642							

FROM A LETTER OF DR. MOESTA TO LIEUT. GILLISS.

Santiago de Chile, *January* 28, 1855.

I INCLOSE some observations of the double star λ *Tucanæ* (216 B. A. C.) and of *Ceres*, which you will be so kind as to forward to Dr. GOULD for the *Astronomical Journal* if you deem it proper. The right ascension and declination of *Ceres* are apparent, (not corrected for observation,) and have been compared with those deduced from the Nautical Almanac, by interpolation with second differences, using the longitude 4ʰ· 42ᵐ· 20ˢ·. You will remark that there are considerable differences between the observed and the computed places, and besides, that these differences are not constant, but seem to vary at a certain rate. What may be the cause of it? Can it depend upon the perturbations, or are the positions in the Nautical Almanac already corrected for observation?* The right ascensions and declinations have been observed with all possible care, and in my opinion cannot be bad observations.

C. W. MOESTA.

ON THE POSITION AND PROPER MOTION OF λ *TUCANÆ*.

BY C. W. MOESTA,

DIRECTOR OF THE NATIONAL OBSERVATORY OF CHILE.

THIS pretty double star was observed by Sir J. HERSCHEL during his residence at the Cape, and his observations for position are the following:† —

Year.	Position.
	° ′
1835.92	78 30
1836.73	80 18
1837.74	80 35

These observations seem to indicate a direct angular motion, and on comparing them with the observations made by Mr. DUNLOP in the year 1826, such a rapid angular motion appeared strongly confirmed; so that Sir J. HERSCHEL recommends this star to the attention of astronomers.

In order to see whether a large proper motion is not perhaps connected with this large variation of position, I made last year, with the meridian-circle of this observatory, the following series of observations for right ascension and declination of the preceding star, observing at the same time the differences in right ascension and declination of its comparison.

---

* The positions of the Nautical Almanac are apparent, i. e. already *affected with* aberration [1854, p. 626, l. 12]. — G.

† *Results of Astronomical Observations*, etc., p. 287.

	Mean α 1854.0.	Mean δ 1854.0.
	h. m. s.	° ′ ″
Sept. 16	0 46 49.796	70 17 39.99
27	50.186	40.34
Oct. 6	50.108	40.47
7	50.240	40.67
9	50.344	41.15
14	49.966	40.81
15	50.166	39.98
16	50 297	41.68
18	50.305	42.03
23	50.402	41.96
Nov. 4	49.636	41.83
9	50.053	41.71
	0 46 50.125	70 17 41.05

The mean of twenty observations for the difference in right ascension gives

$$4^{s}{\cdot}112$$

and the mean of ten observations made by means of the micrometer-screw gives for the difference in declination

$$4''.47.$$

The oldest observation of this star seems to be that of **Lacaille** (No. 250 in his Catalogue), but it remains doubtful whether he observed it as a single or a double star. The position for 1750.0, as stated in the Catalogue, is

$$\alpha = 0^{h.}\ 42^{m.}\ 52^{s}.9\,; \qquad \delta = 70°\ 51'\ 47''.0\,;$$

and from these data we deduce

$$\text{Proper Motion in } \alpha = \frac{237.225}{104} - 2.333 = -0^{s}.052\,;$$

$$\text{“} \quad \text{“} \qquad \delta = -\frac{2045.95}{104} + 19.678 = 0''.005.$$

The preceding star is the same as 114 in **Brisbane**'s Catalogue, and the result of four observations gives its position for 1825.0

$$\alpha = 0^{h.}\ 45^{m.}\ 38^{s}.96\,; \qquad \delta = 70°\ 27'\ 10''.5\,;$$

which would indicate a

$$\text{Proper motion in } \alpha = \frac{71.165}{29} - 2.320 = 0^{s}.134\,;$$

$$\text{“} \quad \text{“} \qquad \delta = -\frac{569.45}{29} + 19.651 = 0''.015.$$

We further obtain, by means of the differences in α and δ, as above mentioned,

Angle of position 77° 52′
Distance 21″.26

On the 22d of December I observed this double star also with the fixed equatorial of our observatory, and obtained

Angle of position 79° 14′ by four observations.
Distance 21″.26 by ten observations.

Both determinations agree well, and leave no doubt in my own mind that the rapid angular motion, as inferred from Mr. **Dunlop**'s observations, does not exist.

OBSERVATIONS OF CERES,

MADE WITH THE MERIDIAN-CIRCLE OF THE SANTIAGO OBSERVATORY, IN THE YEARS 1853 AND 1854.

By C. W. MOESTA.

Date. Mer. Transit.	① α	Nautical Almanac.	Difference.	① δ	Nautical Almanac.	Difference.
1853.	h. m. s.	s.	s.	° ′ ″	′ ″	″
May 17	14 20 12.139	23.623	11.484	— 3 5 28.04	6 30.87	—62.83
19	18 44.155	55.709	11.254	8 19.99:	7 10.37	50.38
21	17 20 892	31.969	11.077	11 19.71	.12 24.34	64.63
June 1	11 6.159	16.508	10.349	39 15.96	40 15.64	59.68
12	7 35.174	45.129	9.955	4 23 15.00	24 11.85	56.85
13	7 24 880	34.574	9.694	27 58.61	28 55.18	56.57
25	7 9.228	19.211	9.983	5 32 51.52	33 44.34	52.82
July 13	14 12 48.808	56.979	8.171	— 7 32 40.52	33 26.79	—46.27
1854.						
Aug. 12	20 58 13.662	32.92	19.258	—30 14 2.97	13 10.99	—51.98
25	47 36.747	55.47	18.723	54 43.36	54 1.27	42.09
28	45 31.371	49.86	18.489	31 0 2.04	1 20.68	41.36
Sept. 5	40 51.504	9.39	17.886	6 48.43	6 13.89	34.54
7	20 39 55.241	12.85	17.609	—31 6 57.24	6 22.10	—35.14

Date. Mer. Transit.	① α	Nautical Almanac.	Difference.	① δ	Nautical Almanac.	Difference.
1854.	h. m. s.	s.	s.	° ′ ″	′ ″	″
Sept. 9	20 39 4.610	22.08	17.470	—31 6 26.10	5 54.22	—31.88
14	37 24.014	41.11	17.096	2 46.29	2 14.81	31.18
15	37 8.390	25.47	17.080	1 36.50	1 6.24	30.26
27	36 2.962	18.79	15.828	30 38 15.80	37 48.61	27.19
Oct. 11	39 20.317	34.67	14.328	29 52 18.63	52 53.40	25.23
14	40 37.319	51.94	14.621	40 19.17	39 53.14	26.03
15	41 6.144	20.29	14.146	36 10.50	35 43.86	26.64
16	20 41 35.708	49.908	14.200	—29 31 57.60	31 28.99	—28.61

The declinations are corrected for parallax, and the latitude of the Observatory has been assumed 33° 26′ 25″.38.

OBSERVATIONS OF EUPHROSYNE,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By JAMES FERGUSON.

[Communicated by Lieutenant MAURY. —Corrected for refraction.]

EUPHROSYNE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉛ — *		㉛'s apparent	
				Δα	Δδ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1855, Jan. 14	6 55 18.1	4	Weisse O. 944	—0 33.72	—11 30.27	0 53 34.50	+ 8 46 11.69
16	7 35 6.2	10	" 950	+0 45.70	—10 37.67	0 55 7.76	9 7 51.83
17	7 13 36.8	4	" 950	+1 32.72	— 0 1.77	0 55 54.77	9 18 27.67
18	7 4 49.6	10	" 980	+0 44.27	+ 9 24.32	0 56 42.52	9 29 9.96
(1) 19	7 40 10.0	11	" 980	+1 33.23	+20 4.70	0 57 31.47	9 39 50.28
22	6 58 8.8	6	" 1076	—0 40.80	+ 7 44.26	1 0 6.37	10 12 42.71
		6	" 1076	—0 48.25	+ 5 41.39	1 0 6.07	10 12 41.56
Feb. 3	7 4 14.6	10	Weisse I. 144	+1 42.35	—20 13.57	1 11 43.83	12 27 14.64
10	8 23 25.9	8	(2)	—1 26.38	— 6 18.06	1 19 26.60	13 48 3.42
17	7 26 15.8	10	B. Z. 394, 123	+1 27.44	+ 7 38.83	1 27 41.48	15 9 14.72
18	7 16 2.3	4	B. Z. 394, 123	+2 40.61	+19 13.03	1 28 54.61	15 20 48.85
20	7 21 43.0	12	B. A. C. 495	—0 1.61	— 9 1.80	1 31 23.99	15 44 9.18
21	7 25 31.5	6	B. A. C. 495	+1 13.96	+ 2 46.51	1 32 39.55	+15 55 57.39

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse O. 950	9	0 54 38.59	+ 9 20 9.73	Weisse's Catalogue.
" 980	9	0 56 14.80	9 21 25.77	" "
" 944	8	0 54 24.71	8 59 21.19	" "
" 1076	9	1 1 3.79	10 6 37.90	" "
" 1079	9	1 1 10.95	10 8 39.90	" "
Weisse I. 144	8.9	1 10 18.36	12 49 6.13	" "
(2)	9.0	1 21 10.01	13 57 57.62	Wash. Eq. from 315 Rümker, 4 comp.
B. Z. 394, 123	9	1 26 31.22	15 3 11.12	Bessel's Zones.
B. A. C. 495	7	1 31 42.94	+15 54 50.50	B. A. Cat. and Rümker's Cat.

(1) Δα not satisfactory.

MINIMA OF ALGOL.

In the 80th number of the *Astronomical Journal*, we published an article on the Variability of *Algol*, by Professor Argelander, in which this eminent astronomer has given full directions for the observation of the minima by means of frequent comparisons of *Algol* with neighboring stars, which do not differ from it too greatly in magnitude. Since no instruments whatever are required for the observation excepting a chronometer or watch, and as there are probably few who cannot obtain the mean time of their place correct to within half or three quarters of a minute, it seems allowable to hope that the interest and aid of many lovers of astronomy may be enlisted for the attainment of numerous series of trustworthy observations during the current year. The paper of Professor Argelander contains an ephemeris of all the minima during the year which are observable in the United States, and copies of the number of the Journal containing it are at the service of any who may be disposed to try their success in these observations.

G.

CARL FRIEDRICH GAUSS

Died at Göttingen, 1855, February 23. A protracted and painful illness, which for more than a year had exhausted his physical energies, although it could not impair the vigor and clearness of his wondrous intellect, had prepared his friends for the hour of separation. Had he remained until the 30th of April, he would have completed his seventy-eighth year. He was well called "the father of sciences."

G.

Cambridge, 1855, *March* 19.

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ON PEIRCE'S CRITERION FOR THE REJECTION OF DOUBTFUL OBSERVATIONS, WITH TABLES FOR FACILITATING ITS APPLICATION.

A REPORT TO PROFESSOR A. D. BACHE, SUPERINTENDENT OF THE U. S. COAST-SURVEY.

By B. A. GOULD, Jr.

[Communicated by Authority of the Hon. Secretary of the Treasury.]

Dear Sir, — In the *Astronomical Journal*, No. 45, Professor Peirce has given the results of the successful investigation of a singular problem, and one unquestionably among the most important of any which could be proposed in its relations to all those exact sciences to which quantitative research or measurement may be applied. This problem was nothing less than the attainment of a formula which should be legitimately derived from the fundamental principles of the Calculus of Probabilities, and furnish an exact criterion for the recognition of those observations which differ so much from the average of a series as to indicate some abnormal source of error, which would vitiate the result. The delicate task of discriminating between such observations, and those whose discordance, although great, ought not to be deemed abnormal, has hitherto been left to the arbitrary judgement of individuals; and the present introduction of a rigorous mathematical ordeal for testing the extent of tolerable discrepancy cannot fail to exercise a highly beneficial influence.

But important as is the use of this criterion, and simple as is its practical application, I am not aware of its adoption in the published discussion of any extended series of observations. In the criticism, however, of various series with which I have had to do in the study of the telegraphic results of the Coast-Survey, I have applied Peirce's Criterion with signal advantage, and have been led to the preparation of tables for facilitating its use. Such tables form a part of my Report upon the Difference of Longitude between the Seaton Station and Raleigh. Subsequently, having in mind its great importance for the discussion of other groups of observations, possibly extremely dissimilar in their character, it has seemed desirable to extend the limits of these tables, and to submit them in an independent form.

The discussion of the formulas is unnecessary, after the reference to the original memoir. But it may not be amiss to repeat them concisely; and perhaps the slightly different form in which I have arranged them, with a view solely to facility in their practical employment, may not be deemed ill-judged.

Let, then,

$m =$ the number of unknown quantities contained in the observations.

$N =$ the whole number of observations.

$\varepsilon =$ the mean error of the series.

$x\,\varepsilon =$ the limit of error which demands the rejection of n observations.

$y =$ the probability that an observation ought to be rejected on account of its discordance.

$\lambda\,\varepsilon =$ the mean error after the n observations have been rejected.

$\psi\,x = \frac{2}{\sqrt{2\pi}} \int_x^\infty e^{-\frac{1}{2}x^2}$, e being the hyperbolic base.

Then, to authorize and require the rejection of n observations, we must have

$$\lambda^{1-y}\ e^{\frac{1}{2}y\,(x^2-1)}\ (\psi\,x)^y < Q$$

or

$$\lambda^{N-n}\ e^{\frac{1}{2}n\,(x^2-1)}\ (\psi\,x)^n < Q^N \qquad (A.)$$

the value of Q being determined by the formula

$$Q^N = \frac{n^n\,(N-n)^{N-n}}{N^N}\,. \qquad (B.)$$

The assumption that the excess of the sum of the squares of the residual errors above the corresponding sum in the series remaining after the n observations have been excluded is only equal to the sum of the squares of the rejected residuals, gives the approximate equation,

$$\lambda^2 = \frac{N - m - nx^2}{N - m - n},$$

whence

$$x^2 = 1 + \frac{N - m - n}{n}(1 - \lambda^2). \qquad (C.)$$

Then if

$$R = e^{\frac{1}{2}(x^2 - 1)}\,\psi\,x \qquad (D.)$$

the equation (A) becomes

$$\lambda^{N-n}\,R^n = Q^N. \qquad (A'.)$$

In the practical employment of these formulas, it will be found most convenient to determine first the value of Q from (B). Next, assuming any approximate R, the corresponding λ is determined by means of (A'), and by substitution in (C) furnishes a value of x from which R may be obtained with greatly increased precision. The computation is then repeated if necessary.

Professor Peirce proposed three tables. The first, containing values of x for the double argument $m' = \frac{m}{N}$ and $y = \frac{n}{N}$, would include the values corresponding to any given number of unknown quantities. The second, a table of single entry, would give log (Br.) Q for different values of y, and the third contain log R, for argument x, being deduced from the solution of equation (D).

This arrangement is unquestionably the neatest and most compendious; still I have concluded to give the tables a greater expansion by employing both n and N as arguments. This demands a separate table for x, corresponding to each value of m; but as the number of unknown quantities implicitly involved will be large in very rare cases only, I have felt less hesitation upon this account, — and the extreme facility of its use will more than compensate for a sacrifice of theoretical elegance. The most frequent case of a number of unknown quantities greater than two is probably that presented by the elements of a celestial body, — all of these elements being supposed unknown. Yet, even here, it will in general be found possible to consider two, if indeed not three, of these as sufficiently known for the purpose of ordinary investigations.

The following Tables I. and II. have therefore been computed by means of approximations through equations (A'), (B), and (C) for every number of observations up to 60 inclusive, and for the several hypotheses corresponding to the rejection of any number less than ten. The former table is calculated for the case of *one* unknown quantity; the latter, for *two*. The function obtained by entering at the side with N, and at the top with n is x^2, which when multiplied by ε^2 gives the limit of Δ^2, the square of the residual of any observation which ought to be tolerated. The value of ε^2 is of course deduced from the formula

$$\Sigma\,\Delta^2 = (N - m)\,\varepsilon^2.$$

It will be carefully borne in mind, that, in the application of these tables, each hypothesis must be tried in succession, beginning with $n = 1$. After it is found that one observation is excluded upon this supposition, the same criterion for two observations may be applied, using the column for $n = 2$, and so on in succession.

No farther explanation seems to be required, but if examples be wished, they may be easily obtained by comparison with the two problems given by Peirce in his memoir (*A. J.*, II. 162). For the first, where $N = 30$, $n = 1$, $m = 2$, our Table II. shows $x^2 = 5.51$; the value obtained in the place cited was after two approximations $x^2 = 5.51$. For the second example, $N = 15$, $m = 2$, $n = 1$; the corresponding limit which the criterion furnishes for the rejection of one observation is $x^2 = 4.080$, and inasmuch as one observation was thus excluded, the limit for the rejection of two is found to be $x^2 = 2.991$.

For those cases especially which fall beyond the limits of Tables I. and II., the tables III. and IV. are added, the former giving by double entry with the arguments n and N the values of log. Q^N deduced from equation (B) for values of N up to 90, and of n to 9 inclusive. The table of single entry proposed by Professor Peirce, and giving the values of log. Q for y, may, like the tables for x, be thus condensed into much smaller compass; but as the values of N increase, the influence of the neglected decimals becomes more and more important, and in the determination of $N \log Q$ we must always apprehend an error amounting to $\frac{1}{2}N$ in the last decimal place. Embarrassment from analogous reasons attends the computation of Q itself, and since many interesting problems in the theory of numbers lead to the use of analogous tables, it has appeared quite desirable to me, while engaged in its preparation, that it should be extended to a sufficient number of decimal places, to permit of its convenient use in still other investigations. To attain the requisite precision, therefore, at least ten, and sometimes more, decimals have been employed, and the seventh place as given may thus be considered trustworthy. For application in the Criterion more than five places will seldom be required, except when it is desired to push the ordeal to a refinement of criticism which will not ordinarily be exercised in a problem of probabilities, and especially when its solution depends upon an approximate assumption like that in equation (C).

The last Table, IV., is that for log. R to argument x, which has been computed by equation (D) to seven, and is here given to six decimal places. To aid in its calculation the table of $\int_0^t \frac{2e^{-t^2}dt}{\sqrt{\pi}}$ given by Encke in the *Berl. Astr. Jahrbuch* for 1834, has been employed, as advised by Professor Peirce. This table was itself deduced from Bessel's table of $e^{t^2}\int_t^\infty e^{-t^2}\,dt$ (*Fundam. Astron.*, pp. 36, 37). The limits are sufficient for all practical purposes; since $x = 3$, the highest value of the argument corresponds to the case of $N = 156$, for one observation deserving exclusion. When the number of observations exceeds this, the series may conveniently be divided into groups of 150 observations each.

I append one of the examples adduced by Peirce, and already cited, to illustrate the practical application of Tables III. and IV., for those who have not the original memoir at hand. The computation is greatly facilitated by the use of the Gaussian logarithms, which are now habitually inserted in the five-figure logarithm tables. For as will readily be perceived on inspecting the figures in the example, we have but to enter column B with the arithmetical complement of log λ^2, to obtain in column C the arithmetical component of log $(1-\lambda^2)$, and, similarly, the argument log (x^2-1) in column A gives log x^2 in column C.

Example. "To determine the limit for rejection of observations in the case of fifteen observations of the vertical semidiameter of *Venus*."

Professor Peirce assumed two unknown quantities, one of them being constant, and the other proportional to the horizontal parallax, and then found for the residual errors,

$-0''.30$	$+0''.48$	$+0''.63$	$-0''.22$	$+0''.18$
-0.41	-0.24	-0.13	-0.05	$+0.39$
$+1.01$	$+0.06$	-1.40	$+0.20$	$+0.10$

We have then $N = 15$, $m = 2$, $\log \varepsilon^2 = 9.53050$.

For the rejection of *one* observation, $n = 1$, and by Table III. $\log Q^N = 8.40442$. Assume for a first hypothesis $\log R = 9.3$.

		I. Approximation.	II.
By (A)	$\log \lambda^{14}$	9.104	9.097
	$\log \lambda^2$	9.872	9.871
	$\log (1-\lambda^2)$	9.407	9.410
By (C)	$\log 12$	1.079	
	$\log (x^2-1)$	0.486	0.489
	$\log x^2$	0.6087	0.6111
	$\log x$	0.3044	0.3056
	x	2.015	2.021
By Table IV.	$\log R$	9.307	

A third approximation would give $x = 2.019$, the same as would be afforded by the more natural assumption of $\log R = 9.305$ instead of 9.307 for the second hypothesis.

The first approximation would, in fact, have been sufficient to indicate that the observation corresponding to the residual $-1''.40$ ought to be rejected, and we pass to the criterion for the rejection of *two* observations as follows: —

$$n = 2, \quad \log Q^N = 7.44195.$$

		I.	II.	III.
Assume	$\log R$	9.3	9.362	9.3544
	$\log R^2$	8.6	8.724	8.7088
	$\log \lambda^{13}$	8.842	8.7179	8.7332
	$\log \lambda^2$	9.822	9.8028	9.8051
	$\log (1-\lambda^2)$	9.522	9.5622	9.5581
	$\log \frac{11}{2}$	0.740	0.7404	
	$\log (x^2-1)$	0.267	0.3026	0.2986
	$\log x^2$	0.455	0.4782	0.4755
	$\log x$	0.228	0.2391	0.2378
	x	1.689	1.734	1.729
	$\log R$	9.362	9.3544	9.3553

The third approximation and the increase in the number of decimals are rendered necessary in this especial case by the close vicinity of the residual $1''.01$ to the limit of exclusion. We find $\log x^2 \varepsilon^2 = 0.005$, which *forbids* the rejection of this observation.

The precise value of x^2 obtained by still farther approximation, and the use of a higher number of decimal figures, would have been, as shown by Table II.,

$$x^2 = 2.9914, \quad \log x^2 = 0.47587, \quad \log \varepsilon^2 x^2 = 0.0064,$$

corresponding to a residual 1.015.

It is needless to remark that, in the actual application of these approximative formulas, the most convenient assumptions for the successive values of log R would not be precisely those yielded by the preceding hypothesis. Moreover, if, owing to the magnitude of any excluded observation, apprehensions be entertained as to the allowableness of equation (C), the most that need be feared is the necessity of a new determination of ε^2 and the corresponding series of residuals.

It is but proper to state that I have been aided in the necessary computations by Mr. J. N. Stockwell of Brecksville, Ohio.

In the hope that these tables may not be without their value in the discussion of the results of the Coast-Survey, I remain, as ever, most respectfully and truly yours,

B. A. GOULD, Jr.

Cambridge, 1854, *November* 15.

To PROFESSOR A. D. BACHE,
Superintendent United States Coast Survey.

* * *

In Tables I., II., and III. the argument N will be found at the side, and n at the top of the table.

TABLE I.

Values of x^2 for $m = 1$.

	1	2	3	4	5	6	7	8	9
3	1.480								
4	1.912	1.163							
5	2.278	1.439							
6	2.592	1.687	1.208						
7	2.866	1.910	1.409	1.045					
8	3.109	2.112	1.588	1.229					
9	3.327	2.295	1.753	1.386	1.091				
10	3.526	2.464	1.904	1.531	1.238				
11	3.707	2.621	2.046	1.662	1.373	1.122			
12	3.875	2.766	2.176	1.785	1.492	1.249	1.018		
13	4.029	2.902	2.299	1.901	1.603	1.362	1.145		
14	4.173	3.030	2.416	2.009	1.709	1.465	1.255	1.053	
15	4.309	3.151	2.526	2.111	1.807	1.561	1.354	1.163	
16	4.436	3.264	2.630	2.207	1.898	1.651	1.445	1.259	1.080
17	4.555	3.371	2.729	2.300	1.985	1.736	1.529	1.347	1.176
18	4.668	3.475	2.824	2.389	2.069	1.817	1.609	1.428	1.261
19	4.776	3.571	2.914	2.474	2.150	1.895	1.685	1.504	1.341
20	4.878	3.664	3.001	2.556	2.227	1.970	1.757	1.576	1.415
21	4.975	3.755	3.084	2.634	2.301	2.041	1.827	1.644	1.483
22	5.068	3.840	3.164	2.709	2.373	2.111	1.893	1.710	1.549
23	5.157	3.923	3.240	2.782	2.442	2.176	1.957	1.773	1.612
24	5.242	4.002	3.315	2.852	2.509	2.240	2.019	1.833	1.671
25	5.324	4.078	3.387	2.920	2.573	2.302	2.079	1.892	1.729
26	5.403	4.151	3.456	2.986	2.636	2.362	2.137	1.948	1.784
27	5.479	4.222	3.523	3.049	2.697	2.420	2.194	2.003	1.838
28	5.552	4.291	3.588	3.111	2.756	2.477	2.249	2.056	1.891
29	5.622	4.358	3.651	3.171	2.813	2.532	2.302	2.108	1.941
30	5.690	4.422	3.712	3.229	2.869	2.586	2.354	2.158	1.990
31	5.756	4.484	3.772	3.285	2.923	2.638	2.404	2.207	2.038
32	5.820	4.545	3.829	3.340	2.976	2.689	2.454	2.255	2.085
33	5.882	4.604	3.884	3.394	3.028	2.738	2.502	2.302	2.130
34	5.942	4.661	3.939	3.446	3.078	2.787	2.549	2.347	2.175
35	6.001	4.717	3.992	3.497	3.127	2.834	2.594	2.392	2.218
36	6.058	4.771	4.044	3.547	3.174	2.880	2.639	2.436	2.261
37	6.113	4.823	4.095	3.595	3.221	2.926	2.683	2.478	2.302
38	6.167	4.874	4.144	3.643	3.267	2.970	2.726	2.520	2.343
39	6.219	4.925	4.192	3.689	3.312	3.013	2.768	2.561	2.383
40	6.270	4.974	4.239	3.734	3.356	3.055	2.809	2.601	2.421
41	6.320	5.022	4.285	3.779	3.398	3.097	2.849	2.640	2.460
42	6.369	5.069	4.331	3.822	3.440	3.138	2.888	2.678	2.497
43	6.416	5.114	4.375	3.865	3.481	3.178	2.927	2.716	2.534
44	6.463	5.159	4.418	3.906	3.520	3.217	2.965	2.753	2.570
45	6.508	5.199	4.460	3.947	3.559	3.255	3.002	2.789	2.606
46	6.552	5.245	4.501	3.987	3.597	3.293	3.039	2.825	2.641
47	6.596	5.287	4.542	4.026	3.637	3.330	3.075	2.860	2.675
48	6.639	5.328	4.581	4.065	3.675	3.366	3.110	2.894	2.708
49	6.681	5.368	4.620	4.103	3.712	3.401	3.145	2.928	2.741
50	6.720	5.408	4.657	4.140	3.748	3.436	3.179	2.962	2.774
51	6.760	5.447	4.695	4.176	3.784	3.471	3.213	2.994	2.806
52	6.800	5.484	4.732	4.212	3.819	3.505	3.246	3.027	2.838
53	6.838	5.522	4.768	4.247	3.853	3.538	3.279	3.059	2.869
54	6.876	5.559	4.804	4.282	3.887	3.571	3.311	3.090	2.899
55	6.913	5.595	4.839	4.316	3.920	3.603	3.342	3.121	2.929
56	6.950	5.630	4.873	4.349	3.952	3.635	3.373	3.151	2.959
57	6.986	5.665	4.907	4.382	3.984	3.666	3.404	3.181	2.988
58	7.021	5.699	4.941	4.415	4.016	3.697	3.434	3.210	3.007
59	7.056	5.733	4.974	4.447	4.047	3.728	3.463	3.239	3.046
60	7.090	5.766	5.006	4.478	4.078	3.758	3.492	3.268	3.074

TABLE II.

Values of x^2 for $m = 2$.

	1	2	3	4	5	6	7	8	9
4	1.484								
5	1.887	1.235							
6	2.230	1.479	1.114						
7	2.528	1.705	1.288	1.025					
8	2.793	1.913	1.459	1.163					
9	3.029	2.102	1.620	1.304	1.066				
10	3.243	2.277	1.771	1.439	1.191				
11	3.437	2.440	1.913	1.566	1.310	1.098			
12	3.616	2.592	2.046	1.687	1.423	1.208	1.015		
13	3.781	2.734	2.171	1.802	1.529	1.310	1.122		
14	3.936	2.867	2.290	1.910	1.631	1.409	1.220	1.045	
15	4.080	2.991	2.403	2.014	1.727	1.501	1.312	1.141	
16	4.215	3.109	2.510	2.112	1.819	1.589	1.398	1.229	1.070
17	4.342	3.221	2.611	2.206	1.907	1.673	1.480	1.311	1.157
18	4.462	3.328	2.708	2.295	1.991	1.753	1.557	1.388	1.236
19	4.576	3.429	2.801	2.382	2.072	1.830	1.631	1.461	1.310
20	4.684	3.526	2.890	2.465	2.150	1.901	1.703	1.531	1.380
21	4.787	3.619	2.975	2.544	2.225	1.976	1.772	1.598	1.447
22	4.885	3.707	3.057	2.621	2.298	2.015	1.838	1.663	1.511
23	4.979	3.792	3.136	2.695	2.368	2.112	1.902	1.725	1.572
24	5.069	3.874	3.212	2.766	2.435	2.176	1.964	1.785	1.631
25	5.155	3.953	3.286	2.835	2.501	2.239	2.024	1.843	1.688
26	5.238	4.029	3.357	2.902	2.565	2.299	2.082	1.900	1.743
27	5.317	4.103	3.426	2.967	2.626	2.358	2.139	1.955	1.796
28	5.394	4.174	3.492	3.030	2.686	2.415	2.194	2.008	1.848
29	5.468	4.242	3.556	3.091	2.744	2.471	2.248	2.060	1.898
30	5.539	4.309	3.619	3.150	2.801	2.525	2.300	2.111	1.948
31	5.608	4.373	3.680	3.208	2.856	2.578	2.351	2.160	1.996
32	5.675	4.435	3.739	3.264	2.909	2.630	2.401	2.208	2.042
33	5.740	4.496	3.796	3.319	2.961	2.680	2.449	2.255	2.088
34	5.803	4.555	3.852	3.372	3.012	2.729	2.496	2.301	2.132
35	5.864	4.613	3.906	3.424	3.062	2.777	2.543	2.345	2.176
36	5.924	4.669	3.959	3.474	3.111	2.824	2.588	2.389	2.219
37	5.981	4.723	4.011	3.523	3.158	2.870	2.632	2.432	2.260
38	6.037	4.776	4.061	3.572	3.205	2.914	2.675	2.474	2.301
39	6.092	4.827	4.111	3.619	3.250	2.958	2.717	2.515	2.341
40	6.145	4.878	4.159	3.665	3.294	3.001	2.759	2.555	2.380
41	6.197	4.927	4.206	3.710	3.338	3.043	2.800	2.595	2.419
42	6.247	4.975	4.252	3.755	3.381	3.084	2.840	2.634	2.457
43	6.297	5.022	4.297	3.798	3.422	3.121	2.879	2.672	2.494
44	6.345	5.068	4.341	3.840	3.463	3.164	2.917	2.709	2.530
45	6.392	5.113	4.384	3.882	3.503	3.203	2.955	2.746	2.566
46	6.438	5.157	4.426	3.923	3.543	3.241	2.992	2.782	2.601
47	6.483	5.200	4.468	3.963	3.581	3.278	3.029	2.817	2.635
48	6.527	5.242	4.508	4.002	3.619	3.315	3.064	2.852	2.669
49	6.570	5.283	4.548	4.040	3.656	3.351	3.099	2.886	2.703
50	6.612	5.323	4.587	4.078	3.693	3.386	3.134	2.920	2.736
51	6.653	5.362	4.626	4.115	3.728	3.421	3.168	2.953	2.768
52	6.694	5.401	4.663	4.151	3.764	3.456	3.201	2.986	2.800
53	6.734	5.440	4.700	4.187	3.798	3.489	3.234	3.018	2.831
54	6.773	5.478	4.736	4.222	3.833	3.523	3.266	3.049	2.862
55	6.811	5.515	4.772	4.257	3.867	3.555	3.298	3.080	2.892
56	6.848	5.551	4.807	4.291	3.900	3.588	3.329	3.111	2.922
57	6.885	5.587	4.842	4.325	3.932	3.619	3.360	3.141	2.951
58	6.921	5.622	4.876	4.357	3.964	3.650	3.390	3.171	2.980
59	6.957	5.656	4.909	4.390	3.996	3.681	3.419	3.200	3.009
60	6.993	5.690	4.942	4.421	4.027	3.711	3.448	3.229	3.037

TABLE III.

VALUES OF N LOG Q.

	1	2	3	4	5	6	7	8	9
2	9.39794 00								
3	9.17069 62	9.17069 62							
4	9.02312 38	8.79588 00	9.02312 38						
5	8.91338 99	8.53857 37	8.53857 37	8.91338 99					
6	8.82594 25	8.31139 25	8.19382 00	8.31139 25	8.82594 25				
7	8.75322 12	8.18122 37	7.92391 74	7.92391 74	8.18122 37	8.75322 12			
8	8.69096 64	8.04624 76	7.70149 39	7.59176 00	7.70149 39	8.04624 76	8.69086 64		
9	8.63653 73	7.92956 37	7.51208 87	7.31490 74	7.31490 74	7.51208 87	7.92956 37	8.63653 73	
10	8.58818 26	7.82677 99	7.34705 00	7.07714 75	6.98970 00	7.07714 75	7.34705 00	7.82677 99	8.58818 26
11	8.54468 05	7.73492 30	7.20076 41	6.96860 67	6.70843 80	6.70843 80	6.86860 67	7.20076 41	7.73492 30
12	8.50514 46	7.65188 50	7.06937 14	6.68278 49	6.46036 13	6.38764 01	6.46036 13	6.68278 49	7.06937 14
13	8.46891 14	7.57611 59	6.95010 02	6.51515 90	6.23830 63	6.10333 02	6.10333 02	6.23830 63	6.51515 90
14	8.43547 11	7.50644 24	6.84089 08	6.36244 75	6.03724 01	5.84783 49	5.78558 01	5.84783 49	6.03724 01
15	8.40142 36	7.44195 47	6.74016 98	6.22219 06	5.85348 11	5.61572 12	5.49903 73	5.49903 73	5.61572 12
16	8.37544 92	7.38193 28	6.64670 76	6.09249 52	5.68424 98	5.40298 78	5.23794 91	5.18352 01	5.23794 91
17	8.34828 81	7.32579 72	6.55952 46	5.97187 19	5.52739 33	5.20659 54	4.99805 46	4.89527 08	4.89527 08
18	8.32272 66	7.27307 46	6.47782 76	5.85912 74	5.38120 85	5.02417 74	4.77610 07	4.62981 48	4.58146 01
19	8.29858 67	7.22337 32	6.40096 51	5.75329 04	5.24432 41	4.85385 27	4.56954 28	4.38372 10	4.29186 42
20	8.27571 85	7.17636 52	6.32839 55	5.65355 98	5.11561 90	4.69110 01	4.37634 99	4.15429 49	4.02290 22
21	8.25399 47	7.13177 32	6.25966 37	5.55926 64	4.99416 46	4 54367 12	4.19487 36	3.93937 83	3.77175 23
22	8.23330 62	7.08936 09	6.19438 32	5.46984 61	4.87918 27	4.40152 82	4.02375 62	3.73721 31	3.53614 72
23	8.21355 87	7.04892 50	6.13222 34	5.38481 82	4.77001 49	4.26679 89	3.86186 58	3.54634 86	3.31423 49
24	8.19467 04	7.01028 92	6.07289 92	5.30377 01	4.66609 86	4.13874 28	3.70824 81	3.36556 98	3.10448 17
25	8.17656 96	6.97330 00	6.01616 25	5.22634 49	4.56694 97	4.01672 57	3.56209 12	3.19385 13	2.90560 21
26	8.15919 32	6.93782 27	5.96179 69	5.15223 19	4.47214 82	3.90020 04	3.42269 77	3.03031 79	2.71650 72
27	8.14248 54	6.90373 86	5.90961 19	5.08115 86	4.38132 74	3.78869 11	3.28946 46	2.87421 67	2.53626 60
28	8.12639 68	6.87094 22	5.85943 91	5.01288 49	4.29416 54	3.68178 16	3.16186 66	2.72489 49	2.36407 61
29	8.11088 29	6.83933 97	5.81112 89	4.94719 82	4.21037 79	3.57910 58	3.03944 33	2.58178 31	2.19924 06
30	8.09590 43	6.80884 72	5.76454 78	4.88390 94	4.12971 26	3.48033 97	2.92178 89	2.44438 12	2.04115 01
31	8.08142 51	6.77938 94	5.71957 61	4.82284 91	4.05194 46	3.38519 52	2.80854 36	2.31224 76	1.88926 91
32	8.06741 32	6.75089 83	5.67610 64	4.76386 55	3.97687 23	3.29341 52	2.69938 72	2.18499 04	1.74312 35
33	8.05383 93	6.72331 25	5.63404 14	4.70682 19	3.90431 49	3.20476 91	2.59403 33	2.06226 01	1.60229 24
34	8.04067 68	6.69657 61	5.59329 31	4.65159 44	3.83410 86	3.11904 92	2.49222 47	1.94374 38	1.46639 96
35	8.02790 16	6.67063 85	5.55378 15	4.55807 09	3.76610 61	3.03606 79	2.39372 96	1.82916 00	1.33510 81
36	8.01549 15	6.64545 31	5.51543 37	4.54614 92	3.70017 25	2.95565 51	2.29833 82	1.71825 47	1.20811 42
37	8.00342 62	6.62097 78	5.47818 31	4.49573 62	3.63618 55	2.87765 62	2.20586 01	1.61079 80	1.08514 37
38	7.99168 71	6.59717 33	5.44196 86	4.44674 65	3.57403 34	2.80193 01	2.11612 21	1.50658 09	0.96594 79
39	7.98025 70	6.57400 41	5.40673 41	4.39910 18	3.51361 35	2.72834 78	2.02896 59	1.40541 27	0.85030 06
40	7.96912 00	6.55143 70	5.37242 79	4.35273 03	3.45183 19	2.65679 10	1.94424 66	1.30711 96	0.73799 54
41	7.95826 15	6.52944 15	5.33900 23	4.30756 56	3.39760 19	2.58715 09	1.86183 13	1.21154 19	0.62884 38
42	7.94766 79	6.50798 94	5.30641 32	4.26354 64	3.34184 36	2.51932 73	1.78159 76	1.11853 29	0.52267 24
43	7.93732 66	6.48705 45	5.27461 98	4.22061 60	3.28748 31	2.45322 77	1.70343 27	1.02795 79	0.41932 22
44	7.92722 58	6.46661 24	5.24358 41	4.17872 19	3.23415 19	2.38876 64	1.62723 23	0.93969 22	0.31864 64
45	7.91735 46	6.44664 05	5.21327 08	4.13781 50	3.18268 65	2.32586 40	1.55289 98	0.85362 06	0 22050 95
46	7.90770 29	6.42711 75	5.18364 71	4.09784 99	3.13212 79	2.26444 69	1.48031 57	0.76963 63	0.12478 61
47	7.89826 09	6.40802 38	5.15468 22	4.05878 42	3.08272 09	2.20444 63	1.40948 66	0.68764 02	90.03135 99
48	7.88901 99	6.38934 09	5.12634 75	4.02057 83	3.03441 42	2.14579 83	1.34024 50	0.60754 02	89.94012 29
49	7.87997 15	6.37105 14	5.09861 61	3.98319 52	2.98715 99	2.08844 32	1.27254 86	0.52925 01	9.85097 43
50	7.87110 77	6.35313 92	5.07146 29	3.94660 00	2.94091 29	2.03232 50	1.20632 97	0.45268 99	9.76382 05
51	7.86242 12	6.33558 89	5.04486 42	3.91076 03	2.89563 13	1.97739 16	1.14152 51	0.37778 45	9.67857 38
52	7.85390 51	6.31838 64	5.01879 78	3.87564 55	2.85127 55	1.92359 39	1.07807 55	0.30446 38	9.59515 23
53	7.84555 28	6.30151 79	4.99324 29	3.84122 68	2.80780 83	1.87088 57	1.01592 54	0.23266 19	9.51347 93
54	7.83735 80	6.28497 08	4.96817 97	3.80747 71	2.76519 49	1.81922 38	0.95502 55	0.16231 71	9.43348 26
55	7.82931 51	6.26873 32	4.94358 97	3.77437 10	2.72340 23	1.76856 75	0.89531 77	0.09337 13	9.35509 49
56	7.82141 84	6.25279 35	4.91945 53	3.74188 43	2.68239 95	1.71887 82	0.83676 47	90.02576 98	9.27825 24
57	7.81366 27	6.23714 11	4.89576 00	3.70999 43	2.64215 71	1.67011 97	0.77931 97	89.95946 10	9.20289 52
58	7.80604 31	6.22176 59	4.87248 80	3.67867 94	2.60264 75	1.62225 77	0.72294 16	9.89439 65	9.12896 69

TABLE III. (*Continued.*)

	1	2	3	4	5	6	7	8	9
59	7.79855 49	6.20665 81	4.84962 46	3.64791 92	2.56384 41	1.57525 99	0.66759 15	9.83053 02	9.05641 41
60	7.79119 37	6.19180 86	4.82715 55	3.61769 45	2.52572 29	1.52909 55	0.61323 23	9.76781 85	8.98518 65
61	7.78395 51	6.17720 87	4.80506 75	3.58798 68	2.48825 96	1.48373 55	0.55982 91	9.70622 10	8.91523 65
62	7.77683 52	6.16285 03	4.78334 77	3.55877 89	2.45143 20	1.43915 23	0.50731 91	9.64569 82	8.84651 89
63	7.76983 01	6.14872 53	4.76198 42	3.53005 40	2.41521 90	1.39531 96	0.45576 12	9.58621 32	8.77899 10
64	7.76293 63	6.13482 64	4.74096 54	3.50179 67	2.37960 04	1.35221 28	0.40503 47	9.52773 11	8.71264 22
65	7.75615 01	6.12114 64	4.72028 03	3.47399 17	2.34455 69	1.30980 80	0.35514 47	9.47021 85	8.64734 39
66	7.74946 84	6.10767 86	4.69991 86	3.44662 50	2.31007 02	1.26808 28	0.30605 52	9.41364 38	8.58314 96
67	7.74288 80	6.09441 61	4.67987 03	3.41968 28	2.27612 30	1.22701 57	0.25774 95	9.35797 68	8.51999 44
68	7.73640 57	6.08135 37	4.66012 59	3.39315 22	2.24269 86	1.18658 62	0.21020 02	9.30318 89	8.45784 52
69	7.73001 88	6.06848 45	4.64067 62	3.36702 09	2.20978 11	1.14677 49	0.16338 38	9.24925 26	8.39667 03
70	7.72372 45	6.05580 32	4.62151 27	3.34127 69	2.17735 51	1.10756 30	0.11727 81	9.19614 19	8.33613 97
71	7.71752 00	6.04330 45	4.60262 71	3.31590 90	2.14540 70	1.06893 29	0.07186 18	9.14383 18	8.27712 46
72	7.71140 30	6.03098 31	4.58401 13	3.29090 63	2.11392 21	1.03086 75	90.02711 47	9.09229 85	8.21869 75
73	7.70537 09	6.01883 40	4.56565 78	3.26625 84	2.08288 73	0.99335 05	89.98301 72	9.01151 93	8.16113 21
74	7.69942 15	6.00685 25	4.54755 93	3.24195 55	2.05229 00	0.95636 63	9.93955 08	8.99147 24	8.10440 35
75	7.69355 25	5.99503 40	4.52970 87	3.21798 80	2.02211 81	0.91990 00	9.89669 76	8.94213 69	8.04848 76
76	7.68776 17	5.98337 42	4.51209 95	3.19434 67	1.99235 98	0.88393 73	9.85444 05	8.89349 29	7.99336 14
77	7.68204 72	5.97186 89	4.49472 52	3.17102 29	1.96300 39	0.84846 44	9.81276 32	8.84552 13	7.93900 28
78	7.67640 68	5.96054 40	4.47757 95	3.14800 82	1.93403 98	0.81346 82	9.77165 00	8.79820 37	7.88539 08
79	7.67083 88	5.94930 56	4.46065 66	3.12529 45	1.90545 71	0.77893 61	9.73108 58	8.75152 25	7.83250 52
80	7.66534 12	5.93824 00	4.44395 06	3.10287 40	1.87724 58	0.74485 58	9.69105 61	8.70546 07	7.78032 61
81	7.65991 24	5.92731 37	4.42745 62	3.08073 93	1.84939 65	0.71121 57	9.65154 70	8.66000 22	7.72883 58
82	7.65455 06	5.91652 31	4.41116 81	3.05888 31	1.82190 00	0.67800 46	9.61251 51	8.61513 13	7.67801 55
83	7.64925 42	5.90586 48	4.39508 11	3.03729 85	1.79474 74	0.64521 17	9.57403 76	8.57083 30	7.62784 82
84	7.64402 16	5.89533 59	4.37919 03	3.01597 89	1.76793 02	0.61282 65	9.53601 21	8.52709 29	7.57831 73
85	7.63885 13	5.88493 30	4.36349 10	2.99491 78	1.74144 03	0.58083 90	9.49845 66	8.48389 71	7.52940 69
86	7.63374 19	5.87465 32	4.34797 86	2.97410 91	1.71526 97	0.54923 96	9.46135 97	8.44123 21	7.48110 16
87	7.62869 18	5.86449 37	4.33264 88	2.95354 67	1.68941 09	0.51801 90	9.42471 03	8.39908 51	7.43338 66
88	7.62369 98	5.85445 16	4.31749 73	2.93322 48	1.66385 65	0.48716 82	9.38849 77	8.35744 37	7.38624 76
89	7.61876 46	5.84452 41	4.30252 00	2.91313 81	1.63859 95	0.45667 86	9.35271 16	8.31629 58	7.33967 09
90	7.61388 47	5.83470 93	4.28774 29	2.89328 09	1.61363 29	0.42651 17	89.31734 21	88.27562 99	87.29364 33

TABLE IV.

Values of Log R for Argument x.

x	0	1	2	3	4	5	6	7	8	9
1.0	9.5014 85	9.4992 09	9.4969 41	9.4946 82	9.4924 31	9.4901 88	9.4879 54	9.4857 29	9.4835 12	9.4813 03
1.1	.4791 02	.4769 10	.4747 25	.4725 49	.4703 80	.4682 20	.4660 67	.4639 23	.4617 86	.4596 57
1.2	.4575 36	.4554 22	.4533 16	.4512 18	.4491 27	.4470 44	.4449 68	.4429 00	.4408 39	.4387 85
1.3	.4367 39	.4347 00	.4326 69	.4306 44	.4286 27	.4266 16	.4246 13	.4226 17	.4206 27	.4186 45
1.4	.4166 70	.4147 01	.4127 39	.4107 85	.4088 36	.4068 95	.4049 60	.4030 32	.4011 11	.3991 96
1.5	.3972 87	.3953 85	.3934 90	.3916 01	.3897 18	.3878 42	.3859 72	.3841 08	.3822 51	.3804 00
1.6	.3785 55	.3767 16	.3748 83	.3730 56	.3712 36	.3694 21	.3676 12	.3658 09	.3640 13	.3622 22
1.7	.3604 37	.3586 57	.3568 84	.3551 16	.3533 54	.3515 98	.3498 47	.3481 02	.3463 63	.3446 29
1.8	.3429 01	.3411 78	.3394 61	.3377 49	.3360 42	.3343 41	.3326 46	.3309 56	.3292 71	.3275 91
1.9	.3259 17	.3242 47	.3225 83	.3209 25	.3192 71	.3176 22	.3159 79	.3143 40	.3127 07	.3110 78
2.0	.3094 55	.3078 37	.3062 23	.3046 15	.3030 11	.3014 13	.2998 19	.2982 29	.2966 45	.2950 65
2.1	.2934 91	.2919 20	.2903 55	.2887 94	.2872 38	.2856 86	.2841 39	.2825 97	.2810 59	.2795 26
2.2	.2779 98	.2764 74	.2749 54	.2734 38	.2719 27	.2704 20	.2689 17	.2674 19	.2659 25	.2644 37
2.3	.2629 52	.2614 72	.2599 96	.2585 24	.2570 57	.2555 93	.2541 33	.2526 78	.2512 26	.2497 79
2.4	.2483 35	.2468 95	.2454 59	.2440 27	.2426 00	.2411 76	.2397 57	.2383 42	.2369 31	.2355 24
2.5	.2341 21	.2327 21	.2313 26	.2299 35	.2285 48	.2271 64	.2257 84	.2244 06	.2230 32	.2216 62
2.6	.2202 96	.2189 33	.2175 75	.2162 19	.2148 68	.2135 20	.2121 76	.2108 36	.2094 99	.2081 66
2.7	.2068 37	.2055 11	.2041 88	.2028 68	.2015 51	.2002 39	.1989 29	.1976 25	.1963 24	.1950 27
2.8	.1937 33	.1924 43	.1911 57	.1898 74	.1885 95	.1873 19	.1860 46	.1847 77	.1835 11	.1822 53
2.9	.1809 98	9.1797 46	9.1784 98	9.1772 52	9.1760 09	9.1747 70	9.1735 33	9.1723 00	9.1710 69	9.1698 42
3.0	9.1686 17									

NEW WORKS.

Astronomical Observations made at the Radcliffe Observatory in the Year 1852. By Manuel J. Johnson, M.A., Radcliffe Observer. Vol. XIII. Oxford. 1854.

The thirteenth volume of the valuable series of *Radcliffe Observations* was published at the close of the year 1854. It consists chiefly of observations for the Circumpolar Catalogue, and of the continuation of this Catalogue itself, as successfully carried out as it was judiciously undertaken. The Appendix contains three Indexes to show the volumes in which the observations of the several stars are respectively published. The first is for the stars of Groombridge's Catalogue, exclusively, the second contains references to observations of 1526 circumpolar stars not observed by Groombridge, and the third relates to 409 stars not circumpolar, i. e. whose north declination does not exceed 40°. A rigorous adherence to the rule laid down by Mr. Johnson, that no star be inserted in his Catalogue until twice observed, renders another year's labor indispensable for the full completion of the Radcliffe Circumpolar Catalogue, an invaluable contribution to astronomy. The recent labors of the eminent astronomers of Bonn and Oxford seem to promise a new era for this most important branch of Practical Astronomy, by furnishing not merely lists of stars, but *absolute positions* determined with a careful precision commensurate with the present demands of the science; — and the announcement of Mr. Johnson, that he has long had in contemplation and now actually commenced a series of observations for the extension of his researches southward, must be a source of gratification to all astronomers.

The assumed latitude of the Observatory is +51° 45′ 36″.0, but the observations for determining the correction of this value have appeared to furnish slightly discrepant results in different years. This correction was, for example, as derived from the observations in 1840, —0″.12; in 1841, —0″.03; in 1842, —0″.30; in 1843, —0″.49; and in subsequent years the deduced value was larger still. This curious fact has at last been explained by the investigations of Mr. Johnson. The assumption of an excess of the tabular refraction will account in great measure for the discordances between the observations of the same circumpolar star at its upper and lower culminations, and will reconcile the chief discrepancies in the latitude determinations. In the Introduction to Volume XII. we find the results of a preliminary discussion of the observations during the decade commencing 1840. The deduced corrections are, —

For the Latitude, +0″.036 (? 0″.36, *v.* R. A. S. Not. XV., 128).
For the Constant of Refraction, —0″.610.

The individual transit-observations over the several threads are omitted in this as in the other volumes of the Radcliffe Series, and, for the sake of convenience and economy of space in printing, only their mean is given. The relative advantage or disadvantage of the complete publication of details will probably long remain a mooted question. One of the most decided arguments in favor of such minuteness of published detail for eye-and-ear observations may doubtless be found in the opportunity afforded for the investigation of the personal peculiarities of the observer in dividing the second, — a curious problem, and one intimately connected with that of personal equation.

In Volume XIV., whose prompt appearance is announced, we are promised the observations made with the splendid Repsold Heliometer of the Radcliffe Observatory, including those for the parallax of 61 *Cygni* and 1830 Groombridge, and for the photometry of stars. A most interesting and valuable dissertation upon the application of the Heliometer to this purpose will be found in Volume XII., — together with the results of observations instituted for the sake of establishing a definite scale of magnitudes.

G.

CORRIGENDA.

In No. 81, page 71, columns 6 and 7, transpose the headings and designations.
" 82, " 77, " 1 and 2, line 28, *for* observation, *read* aberration.

CONTENTS.

On Peirce's Criterion for the Rejection of Doubtful Observations, with Tables for Facilitating its Application, by B. A. Gould, Jr.
New Works.
Corrigenda.

CAMBRIDGE: METCALF AND COMPANY, PRINTERS TO THE UNIVERSITY.

THE
ASTRONOMICAL JOURNAL.
No. 84.

VOL. IV. CAMBRIDGE, 1855, MAY 26. NO. 12.

OBSERVATIONS OF EUPHROSYNE, FLORA, METIS, ASTRÆA, IRENE, MELPOMENE, AND THE THIRTY-FOURTH ASTEROID,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

BY JAMES FERGUSON.

[Communicated by Lieutenant MAURY. — Corrected for refraction.]

EUPHROSYNE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉛ — *		㉛'s apparent	
				Δα	Δδ	α	δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
March 25	7 48 0.7	10	B. Z. 27, 25	−0 20.23	+ 0 47.37	2 18 25.32	+22 14 10.69
	7 48 0.7	10	" 27, 26	−0 33.47	− 0 44.39	2 18 24.85	22 14 8.65
April 3	7 40 5.4	6	" 530, 49	−0 43.98	+ 5 11.87	2 32 59.41	23 58 53.11
7	7 49 41.3	6	B. A. C. 866	−0 36.21	+10 12.76	2 39 42.94	24 45 0.63
	7 50 4.1	5	B. Z. 530, 60	−2 3.26	+ 1 8.93	2 39 42.89	24 41 56.02
12	7 47 45.2	1	" 333, 72	+0 45.72	+11 48.94	2 48 19.27	+25 44 21.93

Adopted Mean Places, 1860.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 27, 25	8	2 19 3.85	+22 14 46.06	Bessel's Zones.
" 27, 26	9	2 19 16.62	22 16 15.71	"
" 530, 49	9	2 34 1.92	23 54 59.42	"
B. A. C. 866	6.7	2 40 37.88	24 36 4.03	B. A. Catalogue.
B. Z. 530, 60	8	2 42 4.94	24 45 3.24	Bessel's Zones.
" 333, 72		2 47 52.44	+25 31 19.14	"

The very unfavorable weather throughout March prevented more frequent observations of this planet.

FLORA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑧ — *		⑧'s apparent	
				Δα	Δδ	α	δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Feb. 21	9 18 23.5	5	(3)	+0 12.41	−19 14.01	10 25 48.27	+17 12 25.88
26	8 29 58.3	11	Rümker 3209	−1 16.92	+ 7 7.09	10 20 39.02	17 50 19.34
27	8 42 14.6	5	B. Z. 456, 21	−1 17.72	+ 5 11.96	10 19 37.13	17 57 31.37
28	8 42 47.6	4	" 18	−0 27.96	+ 6 58.32	10 18 36.27	18 4 26.53
March 1	8 8 36.4	12	" 17	−0 56.97	+13 33.45	10 17 37.78	18 11 8.23
			" 18	−1 26.34	+13 38.46	10 17 37.90	+18 11 6.68

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
(3)	10	10 25 50.85	+17 30 11.28	Wash. Eq. from 3209 Rümker, 4 comps.
Rümker 3209	9	10 22 10.95	17 41 44.42	Rümker's Catalogue.
B. Z. 456, 21	7	10 21 9.88	17 50 51.35	Bessel's Zones.
" 18	7.8	10 19 19.37	17 56 0.37	
" 17	9	10 18 49.71	+17 56 6.97	Bessel's Zones and Rümker's Catalogue.

METIS.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑨ — *		⑨'s apparent	
				Δα	Δδ	α	δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
March 20	8 21 17.2	10	Weisse XII. 409	+0 6.52	+14 59.16	12 24 36.12	+6 48 32.36
		10	" 416	—0 23.93	+15 28.87	12 24 36.05	6 45 33.05
22	8 55 50.2	12	" 359	+0 58.24	+10 33.68	12 22 39.92	6 56 9.77
28	8 28 42.0	12	" 252	+1 9.31	—13 39.33	12 16 52.54	7 25 14.31
April 3	8 55 45.9	10	" 184	—0 49.80	+ 1 30.80	12 11 14.40	7 49 15.07
7	8 44 3.8	5	" 119	—0 44.33	—13 8.53	12 7 43.39	8 2 7.29
		5	" 130	—1 21.34	— 7 38.53	12 7 43.57	+8 1 56.21

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XII. 409	8	12 24 43.63	+6 29 2.16	Weisse's Catalogue.
" 416	9	12 25 14.02	6 28 33.09	
" 359	8.9	12 21 55.70	6 44 4.82	
" 252	9	12 15 57.21	7 37 22.11	
" 184	8.9	12 12 17.57	7 46 11.98	α Weisse's Catalogue ; δ Mural, Prof. Yarnall.
" 119	9	12 8 41.69	8 13 43.10	Weisse's Catalogue.
" 130	8.9	12 9 18.90	+8 8 2.07	

ASTRÆA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑤ — *		⑤'s apparent	
				Δα	Δδ	α	δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
April 7	10 12 0.5	5	B. A. C. 4196	+2 20.84	— 8 11.07	13 23 12.47	—0 12 36.26
11	8 53 52.0	10	Weisse XIII. 318	—0 15.57	— 9 21.44	13 19 54.15	+0 13 3.38
		10	" 321	—0 45.42	—12 58.11	13 19 53.90	+0 12 59.95
12	8 55 15.5	6	" 318	—1 1.51	— 3 8.81	13 19 4.21	+0 19 15.91
		6	" 324	—1 35.61	— 6 43.78	13 19 3.71	+0 19 14.17
16	9 39 13.5	6	" 268	—1 13.57	+16 37.53	13 15 41.08	+0 42 57.66
18	9 37 50.1	8	" 218	+0 30.97	—13 10.19	13 14 7.61	+0 53 46.40

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 4196	7	13 21 5.68	—0 5 48.77	B. A. Catalogue and Rümker's Catalogue.
Weisse XIII. 318	9	13 20 19.75	+0 21 1.09	Weisse's Catalogue.
" 324	9	13 20 53.35	+0 21 34.30	
" 268	8	13 17 11.65	+0 21 56.43	
" 218	9.5	13 13 50.67	+1 5 31.93	

IRENE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑭ — *		⑭'s apparent	
				Δα	Δδ	α	δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
April 12	9 30 59.2	5	B. A. C. 4898	—1 29.78	+9 32.03	14 42 2.58	—1 32 10.61
May 1	8 56 16.6	5	Weisse XIV. 445	+0 27.31	+5 32.97	14 25 3.72	1 3 35.83
	11 41 51.4	4	" 445	+0 20.57	+5 31.25	14 24 56.96	1 3 34.56
4	9 47 59.2	8	" 371	+1 41.21	+3 2.20	14 22 16.32	1 4 12.05
5	8 59 47.3	6	" 362	+1 31.43	+0 41.21	14 21 25.03	1 4 50.05
		6	" 371	+0 52.12	+2 28.53	14 21 24.25	1 4 45.66
6	8 43 33.7	10	" 362	+0 38.29	—0 3.60	14 20 31.89	1 5 34.80
		10	" 371	—0 0.70	+1 42.74	14 20 31.42	—1 5 31.41

Adopted Mean Places, 1860.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 4898	6	14 43 44.56	—1 42 45.76	B. A. Catalogue.
Weisse XIV. 445	8	14 24 50.28	—1 10 8.45	Weisse's Catalogue.
" 371	8	14 20 46.01	—1 8 15.00	
" 362	8	14 20 7.48	1 6 32.24	

MELPOMENE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑱ — *		⑱'s apparent	
				Δα	Δδ	α	δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
April 16	10 56 54.6	5	Weisse XV. 2	—0 4.64	— 1 35.96	15 1 36.57	—2 2 59.54
May 4	10 21 9.9	3	" XIV. 872	0 53.56	—16 15.36	14 45 29.54	—0 6 17.64
		3	" 874	0 56.84	—17 32.88	14 45 28.94	—0 6 14.61
5	10 1 6.0	8	" 872	1 48.48	—11 1.48	14 44 34.62	—0 1 3.72
		8	" 874	1 51.73	—12 20.84	14 44 34.41	—0 1 2.52
6	9 23 47.4	5	" 872	2 45.02	— 5 49.64	14 43 38.09	+0 4 8.17
		5	" 874	2 48.21	— 7 7.12	14 43 37.58	+0 4 11.25
10	10 47 11.0	10	" 748	—0 22.71	+ 4 4.15	14 39 48.45	+0 23 54.88

Adopted Mean Places, 1860.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XV. 2	8.9	15 1 55.41	—2 2 21.34	Weisse's Catalogue.
" XIV. 872	8	14 46 36.90	+0 8 53.07	
" 874	8	14 46 39.59	+0 10 13.63	
" 748	8	14 40 24.94	+0 18 45.11	

THIRTY-FOURTH ASTEROID.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	Planet — *		Planet's apparent	
				Δα	Δδ	α	δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
May 9	11 31 6.1	8	Weisse XIII. 235	+1 33.62	— 6 36.06	13 16 16.17	—4 0 58.11
10	9 43 41.7	11	"	+1 6.97	— 2 47.72	13 15 49.51	3 57 9.77
	10 23 7.8	5	B. A. C. 4477	—0 1.28	+13 6.37	13 15 48.41	3 56 56.61
11	8 35 10.8	10	Weisse XIII. 235	+0 41.13	+ 0 57.86	13 15 23.67	—3 53 24.14

Adopted Mean Places, 1860.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XIII. 235	8	13 14 56.63	—3 55 47.01	Weisse's Cat. and Rümker's Cat.
B. A. C. 4177	6	13 16 3.80	—4 11 27.75	Rümker's Cat. and B. A. Cat.

PLANET-CIRCULAR.

Mr. Le Verrier announces, under date of April 7, that on the previous evening at 10h. 5m. Mr. Chacornac discovered a small planet of the eleventh magnitude, in the thirteenth hour of right-ascension.

Two comparisons with the star 25,438 Lalande furnished the following positions: —

Mean Time.	α	δ
h. m. s.	h. m. s.	° ′ ″
13 10 49.6	13 39 50.02	
28 5.6		—7 28 7.8
15 32 53.9	13 39 45.19	
51 40.1		—7 27 24.2

This new planet, if an asteroid, forms the thirty-fourth of the group.

In the *Astr. Nachr.*, No. 958, are elements for this planet computed by Lesser from the observations

	h. m. s.	° ′ ″	° ′ ″	
1855, April 6,	14 44 14.0	204 57 5.3	—7 27 58.1	Paris.
13,	10 2 54.1	203 36 35.4	6 38 57.2	Vienna, Berlin.
20,	10 49 20.7	202 12 53.3	—5 49 36.6	Berlin.

1855, April 20.4509, Mean Berlin Time.

M	38° 48′ 53″.0	
π	157 51 19.7	M. Eq.
☊	184 1 45.3	1855.0.
φ	6 34 5.0	
i	5 10 10.5	
log a	0.426961	
log μ	2.909565	

Cambridge, 1855, *April* 27.

B. A. GOULD, Jr.

EPHEMERIS OF AMPHITRITE,

COMPUTED FOR MEAN PARIS MIDNIGHT FROM THE ELEMENTS IN THE COMPTES RENDUS, XXXIX. 1064.

By MR. YVON VILLARCEAU.

1855.	㉙ α	㉙ δ	Log △	1855.	㉙ α	㉙ δ	Log △
	h. m. s.	° ′ ″			h. m. s.	° ′ ″	
May 1	20 14 51.77	—27 1 25.7	0.36335	May 30	20 26 44.89	—27 26 21.8	0.28942
2	15 36.27	27 1 15.3	0.36082	31	26 45.84	27 28 23.9	0.28696
3	16 19.51	27 1 8.8	0.35829	June 1	26 45.10	27 30 30.4	0.28452
4	17 1.48	27 1 6.1	0.35574	2	26 42.64	27 32 41.4	0.28210
5	17 42.16	27 1 7.5	0.35320	3	26 38.45	27 34 56.7	0.27970
6	18 21.50	27 1 13.1	0.35064	4	26 32.51	27 37 16.3	0.27731
7	18 59.52	27 1 22.8	0.34809	5	26 24.82	27 39 40.0	0.27495
8	19 36.19	27 1 36.7	0.34552	6	26 15.36	27 42 7.8	0.27261
9	20 11.49	27 1 55.0	0.34295	7	26 4.14	27 44 39.5	0.27029
10	20 45.39	27 2 17.6	0.34038	8	25 51.15	27 47 15.0	0.26800
11	21 17.89	27 2 41.8	0.33781	9	25 36.39	27 49 54.2	0.26573
12	21 48.95	27 3 16.5	0.33523	10	25 19.85	27 52 36.8	0.26350
13	22 18.56	27 3 52.8	0.33265	11	25 1.54	27 55 22.8	0.26129
14	22 46.69	27 4 33.8	0.33007	12	24 41.46	27 58 11.9	0.25911
15	23 13.34	27 5 19.5	0.32749	13	21 19.61	28 1 4.0	0.25697
16	23 38.49	27 6 10.0	0.32492	14	23 56.01	28 3 58.8	0.25486
17	24 2.13	27 7 5.2	0.32234	15	23 30.67	28 6 56.1	0.25278
18	24 24.23	27 8 5.3	0.31977	16	23 3.60	28 9 55.7	0.25075
19	24 44.78	27 9 10.1	0.31720	17	22 34.81	28 12 57.3	0.24875
20	25 3.77	27 10 19.9	0.31463	18	22 4.32	28 16 0.7	0.24679
21	25 21.19	27 11 34.4	0.31207	19	21 32.16	28 19 5.7	0.24487
22	25 37.02	27 12 53.8	0.30952	20	20 58.33	28 22 11.9	0.24300
23	25 51.24	27 14 18.1	0.30697	21	20 22.87	28 25 19.0	0.24117
24	26 3.85	27 15 47.2	0.30113	22	19 45.81	28 28 27.0	0.23938
25	26 14.83	27 17 21.1	0.30190	23	19 7.16	28 31 35.3	0.23765
26	26 24.15	27 18 59.8	0.29938	24	18 26.97	28 31 43.7	0.23596
27	26 31.83	27 20 43.3	0.29687	25	17 45.23	28 37 52.0	0.23432
28	26 37.86	27 22 31.5	0.29437	26	17 2.02	28 40 59.7	0.23273
29	20 26 42.21	—27 24 24.3	0.29189	27	20 16 17.36	—28 41 6.8	0.23120

1855.	㉙ α	㉙ δ	Log △	1855.	㉙ α	㉙ δ	Log △
	h. m. s.	° ′ ″			h. m. s.	° ′ ″	
June 28	20 15 31.28	—28 47 12.7	0.22972	Aug. 29	19 24 3.00	—28 59 22.8	0.26173
29	14 43.82	28 50 17.3	0.22829	30	23 49.05	28 56 19.2	0.26386
30	13 55.03	28 53 20.1	0.22692	31	23 36.95	28 53 11.7	0.26602
July 1	13 4.93	28 56 21.0	0.22561	Sept. 1	23 26.69	28 50 0.4	0.26821
2	12 13.57	28 59 19.6	0.22436	2	23 18.28	28 46 45.4	0.27042
3	11 21.00	29 2 15.6	0.22316	3	23 11.71	28 43 26.9	0.27265
4	10 27.27	29 5 8.7	0.22203	4	23 6.99	28 40 4.9	0.27490
5	9 32.46	29 7 58.3	0.22096	5	23 4.10	28 36 39.6	0.27716
6	8 36.57	29 10 44.6	0.21995	6	23 3.04	28 33 11.1	0.27945
7	7 39.68	29 13 27.0	0.21901	7	23 3.81	28 29 39.5	0.28175
8	6 41.84	29 16 5.3	0.21814	8	23 6.39	28 26 4.9	0.28407
9	5 43.13	29 18 39.1	0.21733	9	23 10.78	28 22 27.2	0.28641
10	4 43.64	29 21 8.1	0.21658	10	23 16.98	28 18 46.7	0.28875
11	3 43.39	29 23 32.1	0.21591	11	23 24.97	28 15 3.4	0.29111
12	2 42.48	29 25 50.7	0.21530	12	23 34.74	28 11 17.4	0.29348
13	1 40.98	29 28 3.8	0.21477	13	23 46.25	28 7 28.7	0.29586
14	0 38.96	29 30 11.1	0.21430	14	23 59.53	28 3 37.4	0.29825
15	19 59 36.53	29 32 12.2	0.21391	15	24 14.54	27 59 43.6	0.30064
16	58 33.72	29 34 6.9	0.21358	16	24 31.26	27 55 47.3	0.30305
17	57 30.62	29 35 55.2	0.21333	17	24 49.69	27 51 48.6	0.30545
18	56 27.31	29 37 36.6	0.21315	18	25 9.78	27 47 47.5	0.30787
19	55 23.87	29 39 11.1	0.21304	19	25 31.53	27 43 44.0	0.31028
20	54 20.37	29 40 38.5	0.21300	20	25 54.92	27 39 38.2	0.31270
21	53 16.92	29 41 58.6	0.21303	21	26 19.92	27 35 30.1	0.31512
22	52 13.58	29 43 11.3	0.21313	22	26 46.51	27 31 19.8	0.31754
23	51 10.43	29 44 16.5	0.21330	23	27 14.68	27 27 7.2	0.31996
24	50 7.55	29 45 14.0	0.21355	24	27 41.38	27 22 52.4	0.32238
25	49 5.01	29 46 3.8	0.21386	25	28 15.61	27 18 35.4	0.32480
26	48 2.87	29 46 45.9	0.21424	26	28 48.33	27 14 16.2	0.32722
27	47 1.21	29 47 20.1	0.21470	27	29 22.54	27 9 54.8	0.32964
28	46 0.10	29 47 46.5	0.21522	28	29 58.22	27 5 31.2	0.33205
29	44 59.61	29 48 5.0	0.21580	29	30 35.33	27 1 5.4	0.33446
30	43 59.84	29 48 15.7	0.21646	30	31 13.87	26 56 37.5	0.33687
31	43 0.80	29 48 18.4	0.21718	Oct. 1	31 53.80	26 52 7.4	0.33927
Aug. 1	42 2.58	29 48 13.4	0.21796	2	32 35.13	26 47 35.1	0.34167
2	41 5.24	29 48 0.5	0.21881	3	33 17.81	26 43 0.5	0.34406
3	40 8.85	29 47 39.8	0.21973	4	34 1.85	26 38 23.7	0.34645
4	39 13.49	29 47 11.5	0.22070	5	34 47.21	26 33 44.6	0.34883
5	38 19.21	29 46 35.6	0.22174	6	35 33.89	26 29 3.2	0.35120
6	37 26.06	29 45 52.0	0.22284	7	36 21.85	26 24 19.6	0.35357
7	36 34.10	29 45 1.0	0.22400	8	37 11.08	26 19 33.5	0.35592
8	35 43.40	29 44 2.6	0.22521	9	38 1.57	26 14 45.1	0.35827
9	34 54.01	29 42 57.1	0.22649	10	38 53.28	26 9 54.3	0.36061
10	34 6.00	29 41 44.3	0.22781	11	39 46.20	26 5 1.1	0.36294
11	33 19.40	29 40 24.6	0.22920	12	40 40.31	26 0 5.4	0.36526
12	32 34.27	29 38 57.9	0.23064	13	41 35.57	25 55 7.3	0.36757
13	31 50.64	29 37 24.5	0.23212	14	42 31.99	25 50 6.6	0.36987
14	31 8.57	29 35 44.5	0.23366	15	43 29.54	25 45 3.4	0.37216
15	30 28.09	29 33 58.1	0.23525	16	44 28.19	25 39 57.6	0.37443
16	29 49.23	29 32 5.4	0.23688	17	45 27.92	25 34 49.2	0.37670
17	29 12.04	29 30 6.6	0.23856	18	46 28.72	25 29 38.2	0.37895
18	28 36.53	29 28 1.8	0.24029	19	47 30.54	25 24 24.5	0.38119
19	28 2.71	29 25 51.2	0.24205	20	48 33.39	25 19 8.1	0.38342
20	27 30.65	29 23 35.0	0.24386	21	49 37.22	25 13 49.0	0.38563
21	27 0.36	29 21 13.3	0.24571	22	50 42.03	25 8 27.1	0.38781
22	26 31.86	29 18 46.3	0.24759	23	51 47.80	25 3 2.4	0.39002
23	26 5.15	29 16 14.2	0.24952	24	52 54.51	24 57 35.0	0.39220
24	25 40.25	29 13 37.1	0.25147	25	54 2.13	24 52 4.6	0.39436
25	25 17.16	29 10 55.2	0.25346	26	55 10.65	24 46 31.4	0.39651
26	24 55.88	29 8 8.7	0.25548	27	56 20.06	24 40 55.3	0.39864
27	24 36.43	29 5 17.7	0.25753	28	57 30.33	24 35 16.2	0.40076
28	19 24 18.80	—29 2 22.3	0.25962	29	19 58 41.46	—24 29 34.1	0.40286

ON AN INTERESTING MECHANICAL PROBLEM.

By R. J. ADCOCK,
PROFESSOR OF MATHEMATICS IN THE KENTUCKY MILITARY INSTITUTE

Required the time occupied by a spherical body rolling down an inclined plane.

Let $M =$ its mass; r, its radius; k, its principal radius of gyration; x, the length of the path described from the point of rest in the direction of the plane at the time t; a, the angle of inclination of the plane; g, the accelerating force of gravity. Then $M g \cos a$ is the component of weight in direction of path. And

$$2 M g x \cos a = M v^2 + M k^2 \frac{v^2}{r^2},$$

because twice the amount of work is equal to the living force generated, which is the living force due to translation *plus* that due to rotation. Hence

$$v^2 = \frac{d x^2}{d t^2} = \frac{2 r^2 g x \cos a}{r^2 + k^2}\,;\ d t = \sqrt{\frac{r^2 + k^2}{2 r^2 g x \cos a}}\ d x.$$

Integrating,
$$t = \sqrt{\frac{2 x (r^2 + k^2)}{r^2 g \cos a}}.$$

The constant of integration is zero, because x vanishes for $t = 0$.

For a sphere of homogeneous density throughout, $k^2 = \frac{2}{5} r^2$. If the mass be concentrated in the surface, $k^2 = \frac{2}{3} r^2$. Hence the time consumed by the first in descending an inclined plane is to that required by the second as $\sqrt{\frac{7}{5}}$ to $\sqrt{\frac{5}{3}}$, or as $\sqrt{21}$ to 5.

This problem suggests the solution of another; viz. Of two spheres of the same size and weight, the one of solid silver-gilt, the other of gold, but hollow, to determine which is the golden and which the silver ball; — a problem which Dr. HUTTON says it is impossible to determine by any mathematical means. The solution is evident from the preceding formula, for the silver ball would roll down an inclined plane in less time than the golden one.

Professor BARTLETT of West Point, in the new edition of his *Analytical Mechanics*, makes the ratio of the time of the sphere of homogeneous density to that of one whose mass is concentrated in surface as $\sqrt{3}$ to $\sqrt{5}$. He has, as is evident from his solution, assumed, incorrectly, that the forces of friction developed in the two cases, (which are just sufficient to make the body roll,) are equal.

FROM A LETTER OF REV. GEORGE JONES, U. S. N., TO THE EDITOR.

Brooklyn, 1855, *May* 17.

IN my recent cruise in the U. S. steam-frigate Mississippi, chiefly in the China and Japan seas, but taking us also around the globe, I had excellent opportunities for observation of the Zodiacal Light. This light, you know, appears to the best advantage within the tropics, where it stretches upward to a great elevation, and is a remarkable object; but it is also very desirable to observe it in high latitudes; and in this also I was favored, as our voyaging extended from 41° north to 53° south latitude; and in some instances our transitions, for weeks together, were very rapid, thus giving me opportunities for observing whether any parallax could be made or not.

I was also fortunate enough to be twice near the latitude of 23° 28′ north, when the sun was at the opposite solstice, in which position the observer has the ecliptic, at midnight, at right angles with his horizon, and bearing east and west. Whether the latter circumstance affected the result or not I cannot say; but I then had the extraordinary spectacle of the Zodiacal Light, simultaneously at both east and west horizons, from 11 to 1 o'clock, for several nights in succession.

In the first part of our cruise my observations were of a desultory character; but I soon began to see the necessity of great precision, and accordingly constructed star-charts from a celestial globe (a small but excellent one) that happened to be on board, which charts I afterwards had cut in wood at Canton; and thus I was furnished with materials for accurately recording all the changes of this phenomenon, not only in successive nights, but also in the successive hours of the same night. My rule was, to draw on my charts the boundaries of the Zodiacal Light as exhibited among the stars, with such annotations as the case required; then, again, do the same after an interval of an hour or half-hour; and so to continue, generally as long as the boundaries could be made out reliably; then, if the morning admitted it, to resume observations at the earliest possible hour, and so to proceed until the dawn. I have thus, in many instances, observations for every hour of the night.

At an early period I began to query whether the moon, when near its full, might not give a Zodiacal Light: and at last, when I had gained more experience in observing, and in the peculiar character of this light, I was able to get, at different periods, fourteen reliable observations of what I think must be considered a Zodiacal Light produced by the moon. I have also two records of a distinct Zodiacal Light produced by the joint action of the sun and moon, i. e. at the hour when the moon, then near its first quartering, was about 65° above the western horizon; the reflection from the combined light of the sun and moon being sufficient to overpower the moonlight proper, and thus to produce a decided stream of light in the sky within the Zodiacal-Light boundaries. The latter of these observations was the more remarkable, inasmuch as the moon was then *without* the boundary of this joint reflected light.

You will excuse my prolixity in stating these varieties of observation, for the conclusion from all the data in my possession is a startling one. It seems to me that these data can be explained only by the supposition of a nebulous ring with the earth for its center and lying within the orbit of the moon. This conclusion seems to evolve itself, — 1st, from the simultaneous midnight east and west observations, which preclude the possibility of a ring around the sun *within* the earth's orbit; 2dly, from the great hourly lateral changes (often semi-hourly) in the boundaries of the Light, caused by the observer's change of place, in that time, as regards the ecliptic or axis of the Zodiacal Light, which lateral change in the Light is too great to allow of our considering it at a distance of 170,000,000 of miles, as its lower end would be, near dawn, if it is a ring around the sun and beyond the earth's orbit; and 3dly, from the moon's Zodiacal Light, if real, which I think it is. That it is a ring, the unbroken continuity of my observations satisfactorily determines. For more than two years, I never failed to see this Light, evening and morning, when the moon and clouds did not interfere; and, except one evening, I have continuous records of this kind.

I could get no parallax; but, on the contrary, as we went south, the boundaries of the Zodiacal Light changed with us to the south among the stars; and so, *vice versa*, towards the north, caused, doubtless, by the ring's presenting new portions of its wide reflecting surface to the sun's light.

GEORGE JONES, *Chaplain U. S. Navy.*

REPORT TO LIEUT. MAURY, SUPERINTENDENT OF THE U. S. NAVAL OBSERVATORY, ON THE OCCULTATION OF *VENUS.*

U. S. Naval Observatory, 1855, *April* 19.

SIR, — I submit the following results and description of the occultation of the planet *Venus*, by the moon, observed with the large Equatorial, on the 18th of the present month. The following are the meteorological indications for the time of observation, taken from the journal of the Observatory.

Bar. 29$^{\text{in.}}$.912 Therm. Attach. 75°.0 Ext. Therm. 70°.5

The night was sultry, with a damp atmosphere, but quite serene and clear till within fifteen degrees of the horizon, below which was a brownish haze as of Indian summer. The dark limb of the moon was distinctly seen with the naked eye until after the occultation. After 8 o'clock the planet became ill-defined, having a reddish-blue tinge. The power of the eye-piece used was 120, with which the following times were observed: —

M. T. Washington.
h. m. s.

8 37 30 The limbs were in contact. This time is uncertain two seconds, owing to the flame-like edge of the planet, the moon's limb being well defined.

8 39 10 The planet was seen half its diameter within the limb of the moon, exhibiting no diminution of light or of magnitude, but showing as if it were on this, and not on the other side of the moon.

8 39 38 The first diminution of magnitude was apparent; the inside or cut edge being straight and well defined; the planet still showing as if projected on the surface of the moon.

The two last phases were observed with great care.

8 40 7 The immersion, which was sudden, but not instantaneous.

No observation of the emersion was attempted.

J. FERGUSON.

NEW COMET.

A SMALL telescopic comet was detected by Dr. SCHWEIZER, at Moscow, on the 11th of April, and observed as follows: —

	α	δ
1855, April 11	184° 40′	—17° 20′
15	182 20	—13 40

1855, *May* 26. G.

THIRTY-FIFTH ASTEROID.

A thirty-fifth member of the group of asteroids was detected by Dr. Luther in Bilk, April 19. He obtained the approximate position, —

1855, April 19, 13h. Bilk M. T. $\alpha = 181° \; 14'$ $\delta = 5° \; 11'$

Professor Peters communicates also two observations by Professor Rümker : —

Hamburg M. T.		Planet's α	Planet's δ	
	h. m. s.	° ′ ″	° ′ ″	
1855, April 21	10 13 18.6	180 57 46.1	—5 10 16.7	19
22	10 40 13.0	49 21.3	—5 10 45 ::	2

Cambridge, 1855, *May* 21. G.

This planet has received from Professors Peters and Rümker the name of *Leucothea*.

NEW WORKS.

The Quarterly Journal of Pure and Applied Mathematics. — Under this title the first number of a new mathematical periodical was issued in London during the last month. It bears the names of Messrs. Sylvester and Ferrers, as editors, assisted by Messrs. Stokes and Cayley of Cambridge (Eng.), and Mr. Hermite of Paris. These names alone afford sufficient indication of the character and promise of the new journal, which, as is stated in the prefatory "Address to the Reader," owes its origin to the discontinuance of the "Cambridge and Dublin Mathematical Journal."

The Editors announce that, "while they propose to tread, as regards the general character of the work, in the path of the journal for which they offer this as a substitute, they will not hold themselves tied down to the laws of a narrow conformity; but among other additions which their own experience, or the suggestions of others during the progress of the work, may recommend to their adoption, it will be their desire to communicate a general idea of all that is passing in mathematical circles, both at home and abroad, that can be of interest to mathematicians as such, and also to furnish historical notices and references which may afford aid in tracing and studying the development of special branches or detached questions of importance in pure and applied mathematics."

We would contribute our mite toward the good work upon which the editors of the new mathematical journal have entered, by earnestly commending it to the cordial sympathy, co-operation, and support of American students of mathematical science.

Cambridge, 1855, *May* 21. G.

NOTICE.

The Editor of this Journal will receive and transmit with pleasure subscriptions and orders for the *Astronomische Nachrichten*, of which Vol. XLI. is just commencing.

The price of a volume in Altona is 8 marks, Hamburg Courant. For numbers forwarded through the mail a higher charge becomes necessary on account of the requisite prepayment of the Transatlantic postage. — The subscription-price for copies forwarded to the United States has been fixed at $ 4.33.

Complete series of the published volumes of the *Astronomische Nachrichten* can no longer be obtained in Altona, but a considerable number, although not constituting a complete series, have been sent to the Editor of this Journal for the convenience of astronomers and literary institutions in the United States desirous of purchasing.

G.

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THE ASTRONOMICAL JOURNAL.

No. 85.

VOL. IV. CAMBRIDGE, 1855, JULY 26. NO. 13.

OBSERVATIONS OF THE SOLAR ECLIPSE OF 1854, MAY 26, REPORTED TO THE SUPERINTENDENT OF THE COAST-SURVEY.

[Communicated by authority of the Hon. Secretary of the Treasury.]

I. OBSERVATIONS AT BROOKLYN, BY EDMUND BLUNT, ESQ., ASSISTANT U. S. COAST-SURVEY.

Brooklyn, 1854, *June* 27.

Dear Sir, — We had a beautiful day for observing the eclipse of the sun on the 26th ultimo, and I selected the corner of Pierpont and Columbia Streets, overlooking the bay, as a place where I would be free from the annoyance of noise or smoke from the city.

The time was determined at Mr. Rutherford's Observatory, and the comparison of the chronometers was made before and after the observations.

	h.	m.	s.
Mean time first contact, ...	4	15	31.65
Mean time last contact, ...	6	37	40.7

Atmosphere remarkably steady *for an observation of this kind*, at the commencement, but towards the end the motion was *wavy*.

I send you drawings of the appearance of the moon's edge near the lower cusp. The table mountains, with the wide valley between (4h. 57m.), are shown also on the daguerreotypes taken by Professor Loomis; but the three peaks (5h. 1m.) and the single peak (5h. 10m.) are not, as the edge is not sufficiently well defined on the plate to show small objects.

No spots were seen on the sun's disc, and I could not detect any roughness on the edge of the moon as shown on the sun, until (4h. 57m.) the table-lands appeared.

Two telescopes were used, the powers of which, as determined by Plössl's dynameter, were 25 and 46.

Latitude 40° 41′ 45″, longitude 73° 59′ 32″ (approximately), from the Chart and Coast-Survey determinations of 1851.

Yours, truly,

EDMUND BLUNT.

PROFESSOR A. D. BACHE,
Superintendent Coast-Survey, Washington.

II. ABSTRACT OF OBSERVATIONS MADE AT THE SEATON STATION, WASHINGTON, D. C., BY C. O. BOUTELLE, ESQ., ASSISTANT U. S. COAST-SURVEY.

With zenith telescope No. 4, C. S., by Simms. Observer, T. McDonnell. Time marked by Mr. F. P. Webber on mean-time chronometer No. 106, by "Eggert," loaned to Coast-Survey by Naval Observatory.

	h.	m.	s.
Observed time of first contact, . .	9	42	26
106 fast, ...	5	39	8
Mean time of observation, . . .	4	3	18

Red-shade glass used; a good deal of irradiation. Eye-piece with power of 55 engraved upon it.

With vertical circle of great theodolite, 48-inch telescope, and eye-piece with power of about 60 used. Violet-colored shade used; limb well defined. C. O. Boutelle, observer; and marking his own time on mean-time chronometer No. $\frac{779}{2227}$, by Cotterell, loaned by Naval Observatory.

	h.	m.	s.
Observed time of first contact, . .	10	18	35
779 fast, ...	6	15	19.9
Mean time of observation, . .	4	3	15.1

Wind fresh from N. W. during P. M.; no clouds. Another observation, by Mr. Würdemann, with a large glass, was not noted with precision, but came between the above, or about 4h. 3m. 16s..5.

Directly after observing first contact, took the following coincidence with sidereal clock, by Kessels, No. 1417, viz.: —

	h.	m.	s.	h.	m.	s.
Clock,	8	5	35	8	8	0
779,	10	23	12.5	10	25	37.0
Clock,	8	6	10	8	8	55
106,	9	47	35.5	9	50	20

Wind fell during eclipse, and became nearly calm at time of greatest obscuration. For temperature, see accompanying table.

Last contact observed by C. O. **Boutelle**, with same instrument and chronometer as the first. Calm; not much tremulous motion. Sun's limb well defined.

	h.	m.	s.
Observed time of last contact, . . .	12	43	1
779 fast, ...	6	15	20.2
Mean time of observation, . . .	6	27	40.8

Last contact observed with zenith telescope No. 4, by Brevet Captain J. L. **Reno**, U. S. A., Assistant Coast-Survey. Time marked by Mr. F. P. **Webber**.

	h.	m.	s.
Observed time of last contact, . . .	12	6	54
106 fast, ...	5	39	8.4
Mean time of observation, . . .	6	27	45.6

Comparison of chronometers with clock, after observing last contact: —

	h. m s.	h. m. s.
Clock,	10 27 5	10 30 46
779,	12 44 19.5	12 47 0
Clock,	10 27 55	10 31 15
106,	12 8 57.5	12 12 17

After which the vertical circle was again placed on the transit-pier at Seaton Station, leveled, and brought into meridian, and observations of transits of stars for local time continued until 11 P. M., when the following comparisons were made: —

	h. m. s.	h. m. s.
Clock,	14 47 42	14 50 40
779,	17 4 15	17 7 12.5
Clock,	14 48 45	14 51 50
106,	16 29 5	16 32 9.5

Temperature before, during, and after Eclipse.

Mean Time at Seaton.	Temp. Fahr.	Mean Time at Seaton.	Temp. Fahr.
h. m.	°	h. m.	°
3 46	82.0	4 59	79.0
3 51	82.0	5 9	77.8
3 56	82.25	5 19	77.5
4 1	82.0	5 29	76.0
4 5	82.0	5 40	75.8
		5 50	75.8
4 12	84.0	6 0	76.25
4 28	82.0	6 10	76.0
4 35	81.75	6 20	76.0
4 39	81.0	6 27	76.2
4 49	80.0	6 37	77.75

Thermometer suspended in shade on east side of Observatory at Seaton Station.

III. OBSERVATIONS AT ROSLYN STATION, NEAR PETERSBURG, VIRGINIA, BY ASSISTANT L. F. POURTALES.

Petersburg, Virginia, 1854, *June* 2.

Sir, — I beg to submit the following report on the observation of the solar eclipse of May 26, made at Roslyn Station, near Petersburg, Virginia.

The telescope used was U. S. C. S. No. 10 (Fraunhofer), with an eye-piece marked 86, — its magnifying power. Seven colored glasses had been provided, but, on trial, I found that none but the one marked No. 3 could be used with comfort; the others were all either too dazzling, or gave a blurred image of the sun. No. 2 could have been used also, but its bright-red color was very fatiguing. No. 3 was a yellow-colored glass, giving a bluish-white appearance to the sun's disc. It cracked very soon after the telescope was pointed to the sun, and I had, in consequence, to look through the edge of it.

The telescope was mounted ten feet west and fourteen feet north of the center of the transit instrument. The beginning of the eclipse was noted at 4$^{h.}$ 4$^{m.}$ 31$^{s.}$.9, Roslyn mean solar time. This is probably two or three seconds too late, owing to the sun's limb not appearing sharp, but undulating.

The end was noted at 6$^{h.}$ 32$^{m.}$ 55$^{s.}$.5, Roslyn mean solar time; but from that time up to 6$^{h.}$ 33$^{m.}$ 13$^{s.}$, I thought I could see stronger undulations on the sun's edge at the point of last contact than along the rest of the limb. The exact instant of disappearance was hard to seize, on account of similar undulations, before the last contact, producing great and rapidly-changing distortions. At no time — before, during, or after the eclipse — could I see any appearance of the moon off the sun's disc.

The part of the sun's disc immediately adjoining the moon's edge appeared more brilliant than the rest.

The cusps were always sharp, but undulations appeared to set out from their extremities, and to run along both edges, this direction agreeing with the direction of the wind.

A thermometer was hung up in the sun (free and uninfluenced by heated atmosphere), and another in the shade, and both read off, from time to time, with the following results: —

Time.	Therm. in Shade.	Therm. in Sun.	Wind. Force.
h. m.	°	°	
3 32	83.8	86.2	N.N.W. 2
4 8	83.4	87.3	N.N.W. 2
4 12	83.2	85.3	N.N.W. 2
4 39	81.2	83.5	N.N.W. 2
4 58	79.4	81.6	N.N.W. 2
5 13	77.2	79.0	N.N.W. 2
5 37	76.1	77.8	Calm.
5 57	75.3	79.4	Calm.
6 17	75.0	78.7	Calm.
6 30	73.6	77.3	Calm.

There seems to be an error in the reading of the thermometer in the sun at 3h. 32m., or it may have been the effect of a passing cloud.

About the time of greatest obscuration, the landscape presented a coloration very similar to that of a clear, calm day at sunset.

Respectfully submitted,

L. F. POURTALES.

PROFESSOR A. D. BACHE,
Superintendent United States Coast-Survey.

IV. OBSERVATIONS AT BLACK MOUNTAIN, SANTA CLARA COUNTY, CALIFORNIA, BY ASSISTANT R. D. CUTTS.

Camp, Black Mountain, Santa Clara County, California, 1854, *May* 28.

Dear Sir, — I send you herewith my observations for the determination of the local time, and of the beginning and ending, of the eclipse on the 26th instant. These observations were made at Black Mountain station, which, being from 1,500 to 1,700 feet above tide, was selected with the expectation that I would be able to overlook the fog, and in this I was not disappointed. The valleys below me, and as far as the eye could reach, were filled, on the 26th, with one dense mass of fog, while it was clear and bright at the station.

With the view, however, to have the eclipse observed in the best manner, and at more than one point, I engaged the following persons to make the necessary observations, and report their results to me to be forwarded to you. The arrangements with respect to telescopes were made when I was in town on the 18th.

Professor Nooney, at Benicia, near triangulation point; Lieutenant Cuyler, U. S. N., at Oakland, near triangulation point; Messrs. Tennent and Anderson, at San Francisco.

The computations for San Francisco were published in the *Alta California;* and those for Oregon were forwarded to the editor of the *Oregonian*, with a request that he would publish them, and interest himself in having the eclipse observed by any one having the requisite instruments. The triangulation will connect all the observations taken near San Francisco with the Coast-Survey Observatory near the Presidio.

With respect to my own observations, I would observe that I think they can be relied on. I took every care and precaution. David Kerr, of Maryland, recorded. The local time has not, I think, a greater probable error than a quarter of a second, and the exact time of the first symptom of the appearance of the moon on the disc of the sun, and of its final disappearance, was obtained as faithfully as the phenomena would admit of. The method of determining the time, and the character of the instruments used, are mentioned in the record. The color of the screen of the eye-glass was red.

With the hope that the results will prove of service, I am, respectfully, yours,

RICHARD D. CUTTS.

PROFESSOR A. D. BACHE,
Superintendent United States Coast-Survey.

Black Mountain Triangulation Station, Santa Clara County, California.

The latitude and longitude of the primary station called Black Mountain are approximately deduced from the published latitude and longitude of the Coast-Survey Observatory near the Presidio, San Francisco County. The two positions being connected by triangulation, so soon as the final computations have been made, the difference in latitude and longitude will be known exactly.

Observatory.

	°	′	″	
Latitude,	37	47	35.6	
Longitude W. of Gr.,	122	26	15.0	= 8h. 9m. 45s.

Black Mountain Station.

	°		″	
Latitude,	37	19	29	
Longitude W. of Gr.,	122	6	58	= 8h. 8m. 27.9s.

The observations for time were taken with a Gambey sextant, artificial horizon, and a pocket chronometer by Jules Jürgensen, and consist of equal altitudes of the sun.

The eclipse was observed with the two-foot telescope belonging to the twelve-inch Gambey theodolite, having an object-glass two and a quarter inches in diameter, and a magnifying power which admitted of about one quarter of the sun's circumference being within the field of vision. A diagonal eye-piece was used.

Error and Rate of Pocket Chronometer by Jules Jürgensen.

Date.	Error at Approximate Noon.	Rate per Day.
1854.	m. s.	
May 22	Slow 0 23.7	s.
23	Slow 0 31.3	Losing 7.6
25	Slow 0 46.5	Losing 7.6
*26	Slow 3 38.3	
27	Slow 3 46.1	Losing 7.8

Results.

	Chron.	Time.	Correction.
	h. m. s.	m. s.	h. m. s.
Beginning of eclipse,	11 23 32.4	3 38.14	11 27 10.54
Ending of eclipse,	2 43 29.6	3 39.54	2 47 9.14

---

* The chronometer ran down on the night of the 25th. It was set, wound up, and started early on the morning of the 26th. The rate does not appear to have altered.

V. OBSERVATIONS AT BENICIA, BY PROFESSOR JAMES NOONEY. — COMMUNICATED BY R. D. CUTTS, ASSISTANT U. S. COAST-SURVEY.

Benicia, Latitude, ...	38° 3′ 5″
Longitude West from Greenwich, ...	122 8 24

Time by Chronometer.	Double Altitude Sun's Upper Limb.	Time by Chronometer (Equal Altitude Sun's Lower Limb).
h. m. s.	° ′ ″	h. m. s.
4 39 31	82 8 40	11 49 52.5
4 41 11.5	82 48 40	11 48 8.5
4 43 21	83 39 0	11 45 56.5
4 45 0	84 18 50	11 44 16
4 46 41.5	84 58 45	11 42 32
4 48 3.5	85 29 40	11 41 18
4 49 31	86 5 0	11 39 42.5
4 50 58	86 39 10	11 37 15
4 52 24	87 12 30	11 36 52
4 53 37	87 40 20	11 35 36.5
Images approaching, used inverting telescope in all the observations.		

Second Set.

Time by Chronometer.	Double Altitude Sun's Lower Limb.	Time by Chronometer (Equal Altitude Sun's Lower Limb).
h. m. s.	° ′ ″	h. m. s.
6 23 21	120 27 20	10 8 36
6 25 31.5	121 14 40	Lost by accident.
6 27 52	122 2 10	10 4 5
6 29 41.5	122 40 40	10 2 15
6 31 18	123 13 40	10 0 38
Images separating.		Images approaching.

Solar eclipse ends 11$^{h.}$ 6$^{m.}$ 33$^{s.}$ by chronometer. Nothing very remarkable was noticed in the appearance of sun or moon. The western cusp of the moon showed at times quite a jagged appearance. The time of ending of the eclipse was entirely satisfactory; the beginning was unsatisfactory, owing to unsteadiness of the air and instrument. The instrument used was a pretty good three-inch repeater, and well mounted for such a portable instrument, but without a diagonal eye-piece. The eye-piece used was rather too high for this purpose, showing only about 45° of the limb of the sun.

The rate of the chronometer before going to Benicia was nothing; after returning, it was gaining one second daily, and performs well.

The sextant observations were designed to be equal altitudes of one limb of the sun; but by an inversion in the first set, different limbs were taken. But the observations themselves give the means of reducing one limb to the other with all accuracy. The observations were made in the yard of the Collegiate Institute, Benicia, Rev. Charles M. Blake, Principal.

JAMES NOONEY, Jr.

VI. OBSERVATIONS AT HUMBOLDT BAY, CALIFORNIA, BY GEORGE DAVIDSON, ESQ., ASSISTANT U. S. COAST-SURVEY.

Humboldt Bay, California, Coast-Survey Station, 1854, *May* 28.

Dear Sir, — Your letter concerning the eclipse was received a few days before the event. I had already calculated it for this place, where I determined to observe it; and had also calculated it for San Francisco, where I sent the times, &c. to be published.

The night and morning preceding the eclipse were very thick and cloudy, and threatening rain; but about half an hour before the commencement the clouds broke, and I got the time of beginning (within eight seconds of my predicted time). I then observed the transit of the moon's second limb as it was projected on the body of the sun, and of the sun's second limb.

The day continued clear, with a north wind blowing "fresh." I obtained the time of ending, and soon after observed two stars for time; clouds set in densely, and no other transits were obtained until next day. The chronometer had been running irregularly for some days previously, and the weather had been such as to preclude anything like transits, except once or twice of the sun, and one or two large stars by day. Mr. Lawson also observed the times of commencement and ending, but the strong wind kept his telescope (Recon. No. 18) too unsteady to make the results reliable.

The following are the data of the solar eclipse of May 26, 1854: —

Coast-Survey Station, Humboldt, California.

	h. m. s.	
Assumed longitude W. of Gr.	8 16 42	(from chron. trip.)
Assumed latitude	40 44 39.25	(from 20 pairs Z. T.)

	h. m. s.
Sidereal time of commencement of eclipse,	3 22 30.79
Sidereal time of ending of eclipse,	6 53 36.19
	h. m. s.
Sidereal time of transit of moon's second limb,	4 12 42.67
Sidereal interval of transit of moon's and sun's second limbs,	0 1 25.88

Telescope used was zenith telescope No. 3 U. S. C. S., with large diagonal eye-piece, and power 65. Colored glass showed the sun white.

Very respectfully, yours,

GEORGE DAVIDSON.

PROFESSOR A. D. BACHE,
Superintendent United States Coast-Survey.

FROM A LETTER OF GEORGE R. VICKERS, ESQ. TO THE EDITOR.*

Baltimore, 1854, *June* 28.

On the 26th of May last the eclipse was observed by me at my place, about three and a half miles west-northwest of Baltimore; and I state at foot the time of contacts; the last contact was probably more correctly observed than the first. The latitude of the place has not been established. As I have not yet completed the residence and observatory now building there, I used a very fine chronometer corrected, or with transit compared, in Baltimore. The aneroid exhibited slight variations. The mercurial barometer only $\frac{1}{100}$° at about 5 P. M.

The magnetic needle, no very decided change.

And the thermometer, which was 86½° at 3$^{\text{h.}}$ 50$^{\text{m.}}$ P. M., gradually descended to 86° at 4$^{\text{h.}}$ 4$^{\text{m.}}$ P. M., to 74½° at 5$^{\text{h.}}$ 40$^{\text{m.}}$ P. M.; ascended to 75½° at 6$^{\text{h.}}$ 25$^{\text{m.}}$ P. M.

Serrated appearances were distinctly observed, and at 5$^{\text{h.}}$ 55$^{\text{m.}}$ P. M., a larger and more definite mountainous appearance on left cusp. No phenomena of color or wavy appearance were observed, although vigilantly looked for through a smoke-colored screen.

The instrument used is a French 4$\frac{1}{8}$ aperture, and power employed, 45. Atmosphere was as fine as could be desired, and not a cloud to be seen.

	h. m. s.
First contact, .	4 4 56.4 P. M.
Last " . .	6 29 5.4 "

Respectfully,

G. R. VICKERS.

FROM A LETTER OF PROFESSOR RÜMKER TO THE EDITOR.

Hamburg, 1855, *May* 4.

I take the liberty of sending you herewith my last observations of some planets.

METIS.

1855.	Hamburg M. T.	⑨ α	⑨ δ	No. Comp.	Comparison-Stars.
	h. m. s.	° ′ ″	° ′ ″		
March 20	8 14 53.0	186 12 49.7	+6 44 12.7	4	*a*, *b*.
29	9 0 3.1	184 1 52.3	7 28 45.4	6	*c*, *d*.
April 7	8 42 12.3	181 58 55.8	8 1 18.1	9	*e*, *f*.
8	8 57 36.1	181 46 12.2	+8 4 0.4	7	*f*.

Apparent Places of Comparison-Stars.

	α	δ		α	δ
	h. m. s.	° ′ ″		h. m. s.	° ′ ″
a	12 21 41.68	+6 45 36.1	*d*	12 17 30.45	+7 9 58.2
b	22 49.72	6 40 39.4	*e*	8 27.71	8 15 15.9
c	12 13 32.81	+7 22 33.7	*f*	12 9 4.92	+8 9 34.5

CIRCE.

1855.	Hamburg M. T.	㉞ α	㉞ δ	No. Comp.	✱ α	✱ δ
	h. m. s.	° ′ ″	° ′ ″		h. m. s.	° ′ ″
April 17	9 44 17.2	202 48 44.6	—6 10 38.8	8	13 34 28.84	—6 14 11.8
18	50 15.8	36 48.6	6 3 36.0	20	30 6.40	5 54 46.7
19	9 34 54.1	202 25 5.9	—5 56 35.4	25	13 30 6.40	—5 54 46.7

LEUCOTHEA.

1855.	Hamburg M. T.	㉟ α	㉟ δ	No. Comp.	✱ α	✱ δ
	h. m. s.	° ′ ″	° ′ ″		h. m. s.	° ′ ″
April 21	10 13 18.6	180 57 46.1	—5 10 16.7	19	12 3 56.05	—5 6 57.3
22	10 40 13.4	180 49 21.3	—5 10 45::	1	"	"

---

* Received in due season, but mislaid through inadvertence of the Editor.

You would oblige me by publishing the results of the Longitudes of the places in the United States marked in the accompanying treatise. I have computed the Longitudes of Cambridge, Washington, Philadelphia, &c.

CHARLES RÜMKER.

The treatise to which Professor Rümker refers, is a memoir upon the computation of Solar Eclipses, with an application of the process to the Solar Eclipse of 1851, July 28. From European and American observations of the end of this eclipse, Professor Rümker has formed tables by which the relative longitudes of the several stations may be deduced. Comparing in this way the several American observations with each of the European ones, he deduces the following longitudes, reckoned West from Greenwich: —

	h. m. s.
Columbia College, New York City,	4 56 10.9
Coast Survey Station, Mount Pleasant (Me.),	4 43 22.8
Philadelphia,	5 0 43.9
Naval Observatory, Washington,	5 8 17.0

From observations of occultations the author has also deduced the difference of longitude between the Hamburg and Cambridge Observatories, as follows: —

	h. m. s.
Aldebaran Emersion, 1848, Feb. 12,	4 44 31.58
" Immersion, 1849, Nov. 29,	4 44 37.20

G.

COMET-CIRCULAR.

Professor Peters communicates to the Editor, June 5, a telegraphic despatch from Dr. Klinkerfues, at Göttingen, announcing the discovery by him of a new comet (1855, II.) on the 4th of June.

1855.	Gött. M. T.	α	δ
		°	°
June 4	10½	104⅓	+36½

Mr. Le Verrier has also sent from Paris, June 6, information that Mr. Dien had discovered at 10 o'clock on the evening of June 4, a comet, which was immediately afterwards obscured by clouds. On the 5th he obtained the following positions: —

1855.	Paris M. T.	α	δ
	h. m. s.	h. m. s.	
June 5	10 24 7.7	7 10 24.83	—
	10 30 5.1	—	+36° 15′ 46″.5

G.

Cambridge, 1855, *June* 22.

This comet had been detected by Dr. Donati, at Florence, on the previous day. The discoverer has sent the following observations to the *Astronomische Nachrichten*, No. 968: —

1855.	Florence M. T.	☄ − * Δα	☄ − * Δδ	No. Comp.	☄ α	☄ δ	* α	* δ
	h. m. s.	m. s.	′ ″		h. m. s.	° ′ ″	h. m. s.	° ′ ″
June 3	10 4 10	—2 17.18	+22 0.0	2	—	—	—	—
4	9 55 12	+2 37.78	— 9 22.9	1	6 56 56.27	+36 22 5.5	6 54 18.49	+36 31 28.4
5	9 18 36	—4 2.41	—20 12.5	1	7 10 32.73	+36 15 15.1	7 14 35.14	+36 35 27.6

The comparison-star of June 3d was of the 10.11 magnitude; those of the 4th and 5th were Lal. 13569 and 14298 respectively. Dr. Donati was unable to detect nucleus or tail, and estimated it as fainter than the nebula in *Hercules*.

Cambridge, 1855, *July* 7.

SECOND COMET OF 1855.

From the observations at Berlin, June 5, 6, 7, Mr. Bruhns has computed the following elements: —

T	1855, May 29.23896 Berlin M. T.
	° ′ ″
π	240 15 18.4
☊	260 52 43.1
i	22 58 27.1
Log q	9.745678
	Retrograde.

Among the observations of this comet, the following are given in the *Astr. Nachrichten* : —

1855.	Place.	M. T. of Place.	☄ α	☄ δ
		h. m. s.	h. m. s.	° ′ ″
Jan. 5	Göttingen	10 21 16	7 11 8.52	+36 15 52.1
7	Florence	9 48 13	7 33 39.35	35 50 46.1
9	"	10 2 34	7 51 10.38	35 16 24.7
11	Vienna	10 34 41	8 4 36.03	+34 39 55.9

ELEMENTS AND EPHEMERIS OF URANIA.

By Mr. GÜNTHER,

ASSISTANT IN THE BRESLAU OBSERVATORY.

Ephemeris for Mean Berlin Noon.

1855.	α	δ	Log △
	h. m. s.	° ′	
Oct. 1	8 1 9	+21 43.0	0.36774
3	4 25	21 33.2	0.36399
5	7 38	21 23.2	0.36017
7	10 48	21 13.2	0.35628
9	13 54	21 3.1	0.35231
11	16 56	20 53.0	0.34827
13	19 54	20 42.9	0.34417
15	22 49	20 32.8	0.34001
17	25 39	20 22.7	0.33579
19	28 26	20 12.7	0.33149
21	31 8	20 2.7	0.32713
23	33 46	19 52.8	0.32271
25	36 19	19 43.0	0.31822
27	38 48	19 33.3	0.31366
29	41 12	19 23.7	0.30904
31	43 32	19 14.3	0.30437
Nov. 2	45 46	19 5.0	0.29965
4	47 56	18 56.0	0.29486
6	50 0	18 47.2	0.29001
8	51 59	18 38.6	0.28510
10	53 52	18 30.4	0.28015
12	55 40	18 22.4	0.27517
14	57 21	18 14.7	0.27015
16	8 58 57	18 7.3	0.26508
18	9 0 26	+18 0.3	0.25998
Nov. 20	9 1 50	+17 53.6	0.25484
22	3 7	17 47.3	0.24968
24	4 17	17 41.4	0.24452
26	5 20	17 36.0	0.23936
28	6 17	17 31.0	0.23420
30	7 6	17 26.4	0.22904
Dec. 2	7 48	17 22.4	0.22388
4	8 22	17 18.8	0.21874
6	8 49	17 15.8	0.21365
8	9 7	17 13.3	0.20862
10	9 18	17 11.3	0.20364
12	9 21	17 9.8	0.19872
14	9 16	17 8.8	0.19388
16	9 3	17 8.4	0.18914
18	8 42	17 8.6	0.18451
20	8 13	17 9.3	0.18000
22	7 35	17 10.5	0.17564
24	6 50	17 12.3	0.17144
26	5 57	17 14.5	0.16741
28	4 56	17 17.3	0.16355
30	3 46	17 20.4	0.15987
1856.			
Jan. 1	2 30	17 24.1	0.15641
3	9 1 7	17 28.2	0.15323
5	8 59 37	+17 32.7	0.15029

This Ephemeris is derived from the following

Elements.

1855, January 1.0, Mean Time Berlin.

M	335° 39′ 29″.7	
π	30 48 46.8	M. Equinox
☊	308 11 6.1	of the Epoch.
i	2 5 56.5	
φ	7 15 41.2	
μ	975″.20787	
Log a	0.3739396	

Computed from four normal places, 1854, July 23.0, August 28.0, October 3.0, November 16.0, mean time Berlin.

NEW WORKS.

Results of Astronomical Observations made at the Observatory of Harvard College, under the Direction of William Cranch Bond, A. M.

An elegantly printed volume of 316 pages, the first of the publications of this Observatory, and numbered as Part II. of the first volume; the results of previous observations of the Observatory being intended for subsequent publication, as Vol. I. Part I. — The present publication contains a catalogue of 5500 stars to the 12th magnitude inclusive, situated between 0° and 0° 20′ of North Declination. They were observed during the years 1852 and 1853 with the great equatorial telescope of the Observatory, in the form of zones 10′ broad, and are published in the same form, referred to the mean equinox of the beginning of the year.

The title-page states that the volume is "printed from funds resulting from the will of Josiah Quincy, Jr., who died in April, 1775, leaving a name inseparably connected with the history of the American Revolution." — It is understood that these funds, which had been conditionally bequeathed, have been presented to the Observatory, and devoted to the publication of its annals, by the pious liberality of the son of the testator, the honored Ex-President of Harvard College.

1855, *July* 16.

G.

NOTICE.

With the present number of this Journal is distributed the photographic sheet, Vol. IV. Plate 1, originally intended to accompany Professor Bartlett's Memoir upon the Solar Eclipse of May, 1854, and which was announced as to be delivered with the next following number (78). The Editor, deeply regretting this delay, desires to assure the readers of the Journal that no pains have been spared on his part to fulfil this intention, and that the delay is due to unexpected obstacles, which prevented the photographer, Mr. Prévost, from attaining the results which he had anticipated, and confidently announced. — The impression should be viewed by transmitted light, and in binding, the sheet should be attached at its edges only to a leaf so cut away as to permit of examination in this manner. — The preparation and distribution of these photographs has been rendered possible only by the liberality of the Smithsonian Institution.

1855, *July* 14.

G.

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A volume of the *Astronomical Journal* consists of twenty-four numbers, with a table of contents and alphabetical index. The price of subscription is $ 5.00, payable in advance.

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New Works.
Notice.

CAMBRIDGE: METCALF AND COMPANY, PRINTERS TO THE UNIVERSITY.

THE

ASTRONOMICAL JOURNAL.

No. 86.

VOL. IV. CAMBRIDGE, 1855, SEPTEMBER 5. NO. 14.

OCCULTATIONS OF STARS OBSERVED AT THE SANTIAGO OBSERVATORY IN THE YEARS 1852 AND 1853.

MADE WITH THE $8\frac{1}{2}$ FOOT EQUATORIAL. — POWER, 150.

By C. W. MOESTA,

DIRECTOR OF THE OBSERVATORY.

Date.	Santiago Sidereal Time. h. m. s.	Mag.	Star.	Phase.	Remarks.
1852, Sept. 19	19 19 26.69	7	6880 B. A. C.	Immersion.	Good.
Oct. 15	22 21 3.86	7	29338 Lalande.	“	“
17	0 6 51.74	7	6165 B. A. C.	“	“
17	0 11 49.96	8.9	33386 Lalande.	“	Doubtful 1^{s}.
23	2 2 15.28	8	Hora 23 Weisse 573	“	Good.
Nov. 19	1 15 55.58	5	ψ^3 *Aquarii.*	“	Very good.
Dec. 15	3 27 38.14	7.8	43367 Lalande.	“	Good.
16	1 45 48.86	8	Hora 22 Weisse 1122	“	“
16	1 50 26.07	9	“ 22 “ 1126	“	“
18	3 15 25.31	9	“ 0 “ 467	“	“
20	4 32 52.78	8.9	“ 1 “ 1005	“	“
20	6 48 23.20	8	“ 1 “ 1071	“	“
1853, Jan. 12	3 47 5.78	8.9	“ 22 “ 707	“	Doubtful 1^{s}.
12	4 17 32.11	7	“ 22 “ 736	“	Good.
16	4 19 59.16	9	“ 1 “ 694	“	“
18	4 39 35.98	9	“ 3 “ 148	“	Not very good.
19	5 56 13.35	7.8	*a*	“	Good.
21	5 9 32.11	8.9	*b*	“	“
21	7 2 8.55	8	*c*	“	“
22	6 21 54.47	7.8	*d*	“	Doubtful some seconds.
Feb. 9	6 11 45.46	7½	204 B. A. C.	“	Good.
16	5 43 0.14	9	8596 Lalande	“	“
18	6 1 24.41	7	*e*	“	“
19	5 12 38.90	7.8	2363 B. A. C.	“	“
19	5 30 33.82	6	2364 “	“	“
22	8 54 50.82	3½	η *Leonis.*	“	Doubtful 2^{s}.
22	9 8 18.83	“	“	Emersion.	Very good.

The positions of the stars *a*, *b*, *c*, *d*, *e*, have been determined from a single observation with the Meridian-Circle, and must therefore be considered only as approximate. They are as follows: —

Mean Places, 1853.0.

		h. m. s.	° ′ ″
Star	*a*	$\alpha =$ 3 58 6.56	$\delta =$ 18 44 52.9
“	*b*	5 37 0.70	23 40 57.1
“	*c*	5 39 40.46	23 42 46.3
“	*d*	6 36 22.61	21 49 2.2
“	*e*	$\alpha =$ 6 11 4.36	$\delta =$ 24 37 18.8

LETTER FROM PROFESSOR ALEXANDER TO THE EDITOR.

Princeton, 1855, *July* 30.

There would seem to be no inconsiderable resemblance between the elements of the second comet of 1855 and those of the comet of 1362.

The two sets of elements of the latter computed by Burckhardt, when corrected for the change of style and for precession, will read very nearly as follows: —

Orbit I.	T	1362, March 19$^{d.}$ 5$^{h.}$ Paris.
	π	226°
	☊	256
	i	21
	Log q	9.65875
		Retrograde.
Orbit II.	T	1362, March 10$^{d.}$ 8$^{h.}$ Paris.
	π	234°
	☊	244
	i	32
	Log q	9.672144
		Retrograde.

Mr. Bruhns's elements of Comet II. of 1855, as given in No. 85 of the *Astronomical Journal*, and which may here be repeated for the purpose of comparison, are: —

T	1855, May 29.23896	Berlin M. T.
π	240° 15′ 18″.4	
☊	260 52 43.1	
i	22 58 27.1	
Log q	9.745678	
	Retrograde.	

It will be observed that both of the orbits of 1362 differ less in several respects from that of 1855, II. than those orbits differ among themselves; the agreement with the orbit of the comet recently discovered being the more perfect in the instance of Orbit I.

STEPHEN ALEXANDER.

INVESTIGATION OF THE ELEMENTS OF THE ORBIT OF EUPHROSYNE.

By JAMES FERGUSON.

For the computation of these elements, the following normal places were used: —

M. T. Berlin.	α	δ
1854, Sept. 6.0	27° 42′ 50″.40	— 2° 51′ 9″.88
" Dec. 21.0	10 12 52.79	+ 4 40 33.37
1855, April 7.0	39 41 34.50	+24 38 38.15

The first of these places is derived from Washington observations of the 2d, 6th, and 10th of September; the second, from Vienna and Washington observations of the 18th, 20th, and 21st of December; and the third, from Washington observations of the 3d and 7th of April. In reducing them to the epochs chosen, and correcting them for aberration and parallax, an ephemeris was used computed from the first set of elements published in the *Astronomical Journal*, Vol. IV. p. 55.

The ordinates, referred to the ecliptic and the mean equinox of 1855.0, are as follows: —

M. T. Berlin.	l	b
1854, Sept. 6.0	24° 39′ 46″.97	—13° 22′ 34″.63
" Dec. 21.0	11 13 25.06	+ 0 15 11.20
1855, April 7.0	44 58 8.01	+ 8 42 28.81

From these, using Dr. Encke's* modification of Gauss's Formulas, were obtained the following elliptic elements.

M	319° 58′ 30″.66	1855.0 Berlin
☊	31 25 18.11	Mean Equinox, 1855.0.
π	93 50 3.37	
i	26 24 44.26	
φ	12 27 40.38	
Log a	0.4990081	
" μ	2.8014944	

The following ephemeris, for the apparent equinox of the respective dates, was then computed for every fourth day of the whole period of the visibility of the asteroid in 1854, 1855; the constants for computing the equatorial ordinates for the mean equinox of 1855.0 being

$$\text{Sin } a = 9.9879963 \qquad A = 181° \; 5' \; 52''.56$$
$$\text{Sin } b = 9.8509256 \qquad B = 101 \; 47 \; 48.83$$
$$\text{Sin } c = 9.8703590 \qquad C = 78 \; 39 \; 22.40$$

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* "*Ueber die Bestimmung einer elliptischen Bahn aus drei vollständigen Beobachtungen.*" — *Astronomisches Jahrbuch*, 1854.

The following typographical error in this paper may be troublesome, from the place at which it occurs, on p. 371: —

§26, *for* $\frac{(t''-t)}{(r \sec \psi)^3}$, *read* $\frac{(t''-t)}{(r \sec^2 \psi)^3}$.

I notice also the following typographical error in Dr. Encke's edition of Dr. Olbers's *Abhandlung*, &c., on p. 240: —

§V. *for* $g \cos \psi - f''' R''' \cos \psi'''$, *read* $g \cos \varphi - f''' R''' \cos \psi'''$.

Ephemeris.

M. T. Berlin.		α	δ	Aber. Time.	π	M. T. Berlin.		α	δ	Aber. Time.	π
1854, Aug.	29	28° 28′ 25″.4	− 3° 1′ 55″.4	0.012683	3″.87	1854, Dec.	23	10° 21′ 22″.2	+ 4° 59′ 14″.2	0.013566	3″.61
Sept.	2	28 7 6.4	2 57 41.1	.012405	3.95		27	10 42 24.9	5 37 24.9	.013842	3.54
	6	27 42 47.0	2 54 6.3	.012146	4.03		31	11 8 39.4	6 16 36.3	.014120	3.47
	10	27 12 27.8	2 50 50.9	.011902	4.11	1855, Jan.	4	11 39 48.3	6 56 42.8	.014400	3.40
	14	26 36 13.0	2 47 48.8	.011678	4.19		8	12 15 36.7	7 37 40.6	.014673	3.34
	18	25 54 13.1	2 44 50.0	.011473	4.27		12	12 55 53.2	8 19 26.7	.014953	3.27
	22	25 6 48.6	2 41 39.1	.011291	4.34		16	13 40 25.6	9 1 58.1	.015230	3.21
	26	24 14 26.8	2 38 3.1	.011131	4.40		20	14 28 53.7	9 45 11.6	.015501	3.15
	30	23 17 44.7	2 33 47.0	.010996	4.45		24	15 21 15.0	10 29 5.2	.015770	3.10
Oct.	4	22 17 27.3	2 28 36.8	.010888	4.50		28	16 17 12.3	11 13 33.4	.016032	3.05
	8	21 14 23.3	2 22 19.5	.010803	4.53	Feb.	1	17 16 34.0	11 58 33.1	.016290	3.01
	12	20 9 23.9	2 14 45.2	.010751	4.55		5	18 19 10.8	12 44 1.5	.016580	2.95
	16	19 3 30.1	2 5 41.5	.010723	4.57		9	19 25 53.5	13 29 54.8	.016786	2.92
	20	17 57 41.5	1 51 58.5	.010723	4.57		13	20 33 36.3	14 16 10.4	.017024	2.88
	24	16 53 1.8	1 42 28.7	.010748	4.55		17	21 45 10.5	15 2 46.3	.017255	2.84
	28	15 50 34.1	1 28 4.9	.010790	4.53		21	22 59 31.4	15 49 38.8	.017477	2.80
Nov.	1	14 51 12.4	1 11 45.1	.010835	4.50		25	24 16 31.4	16 36 43.6	.017691	2.77
	5	13 55 47.0	0 53 28.0	.010986	4.46	March	1	25 36 3.2	17 23 58.8	.017895	2.74
	9	13 5 0.7	0 33 14.5	.011113	4.40		5	26 58 1.2	18 11 18.7	.018091	2.71
	13	12 19 24.5	− 0 11 8.3	.011261	4.35		9	28 22 23.2	18 55 42.1	.018279	2.68
	17	11 39 30.7	+ 0 12 47.2	.011430	4.28		13	29 49 6.8	19 46 5.1	.018454	2.65
	21	11 5 39.0	0 38 31.8	.011617	4.21		17	31 18 7.6	20 33 23.9	.018622	2.63
	25	10 38 7.3	1 6 0.9	.011821	4.14		21	32 49 26.2	21 20 38.1	.018780	2.61
	29	10 17 1.6	1 35 8.7	.012040	4.07		25	34 22 53.2	22 7 39.9	.018931	2.59
Dec.	3	10 2 19.8	2 5 50.0	.012271	3.99		29	35 58 35.9	22 54 29.3	.019063	2.57
	7	9 53 59.3	2 37 56.6	.012514	3.91	April	2	37 36 19.5	23 40 57.9	.019191	2.55
	11	9 51 52.8	3 11 21.7	.012766	3.83		6	39 16 14.7	24 27 10.1	.019307	2.53
	15	9 55 52.4	3 46 9.9	.013027	3.75		10	40 58 14.5	25 12 52.4	.019414	2.52
	19	10 5 46.1	+ 4 22 7.6	0.013293	3.68		14	42 42 20.6	+25 58 9.7	0.019510	2.51

From this ephemeris, interpolated for each day, all the observations of the asteroid known to me were corrected for planetary aberration and parallax, and compared with the places computed from the same ephemeris for the times of observation. The following table shows the observed places and the differences from those computed. A few observations only, where the star observed has evidently not been the planet, have been omitted. In this table A. J. signifies the *Astronomical Journal*, and A. N. the *Astronomische Nachrichten*; the Roman numerals signify the volume, and the Italian ones the page, of each work.

Place of Observation.	M. T. Berlin.	㉛ α	δ	C. − O. Δα	Δδ	Authority.	
Washington,	1854, Sept. 2ᵈ.74608	*28° 3′ 0″.70	−2° 57′ 5″.39	− 0″.69	+ 3″.69	A. J. IV. 71	A. N. XL. 251
Washington,	6.90918	*27 36 26.36	2 53 22.56	− 1.89	+ 2.52	A. J. IV. 71	A. N. XL. 251
Washington,	10.91942	*27 4 41.61	2 50 11.22	− 3.50	+ 1.72	A. J. IV. 71	A. N. XL. 251
Washington,	12.67103	26 48 29.71	2 48 50.65	+15.09	+ 0.78	A. J. IV. 71	A. N. XL. 251
Washington,	12.67103	26 48 48.45	2 48 49.63	+ 5.37	+ 2.24	A. J. IV. 71	A. N. XL. 251
Cloverden,	12.78853	*26 47 50.46	2 48 42.31	− 1.51	+ 2.23	A. J. IV. 36	
Washington,	14.67082	26 29 17.21	2 47 21.61	+16.30	+ 2.79	A. J. IV. 71	A. N. XL. 251
Washington,	16.68940	26 8 21.14	2 45 51.90	+14.72	+ 1.90	A. J. IV. 71	A. N. XL. 251
Washington,	17.67634	25 57 41.53	2 45 4.84	+ 7.87	− 0.09	A. J. IV. 71	A. N. XL. 251
Cloverden,	17.73899	*25 57 11.43	2 45 2.60	− 3.67	+ 0.51	A. J. IV. 36	
Cloverden,	20.73677	25 22 25.81	2 42 41.82	− 6.81	+ 0.62	A. J. IV. 36	
Washington,	21.66942	25 10 50.33	2 42 0.80	+ 4.91	+ 5.53	A. J. IV. 71	A. N. XL. 251
Cloverden,	21.73975	25 9 52.49	2 41 55.21	+10.56	+ 3.12	A. J. IV. 36	
Washington,	22.65930	24 58 31.81	2 41 13.49	− 1.97	+ 8.16	A. J. IV. 71	A. N. XL. 251
(1)Cloverden,	22.74369	24 57 33.96	2 41 1.13	− 8.35	− 0.26	A. J. IV. 36	
Washington,	23.65602	24 45 31.59	2 40 14.67	+ 9.45	+ 1.79	A. J. IV. 71	A. N. XL. 251
Cloverden,	23.82831	24 43 26.72	2 40 5.38	+ 0.23	+ 1.66	A. J. IV. 36	
Washington,	24.63021	24 32 45.79	−2 39 21.29	+ 7.84	+ 1.30	A. J. IV. 71	A. N. XL. 254

(1) The declination is corrected +20″.87 a revolution of the micrometer.

Place of Observation.	M. T. Berlin.	(31) α	δ	C. — O. $\Delta\alpha$	$\Delta\delta$	Authority.	
	d.	° ′ ″	° ′ ″	″	″		
Cloverden,	1854, Sept. 21.74242	24 31 22.87	— 2 39 15.36	+ 1.45	+ 0.55	A. J. IV. 36	
Washington,	26.64996	24 5 21.78	2 37 28.02	+ 8.51	+ 3.00	A. J. IV. 71	A. N. XL. 254
Bonn,	29.58603	*23 23 49.65	2 34 19.01	— 1.56	+ 2.96		A. N. XXXIX. 299
Berlin,	29.60156	*23 23 32.42	2 34 16.86	+ 1.82	+ 0.93		A. N. XXXIX. 375
Washington,	29.64506	*23 22 51.26	2 34 14.45	+ 5.02	+ 2.55	A. J. IV. 71	A. N. XL. 254
Bonn,	30.48417	*23 10 42.18	2 33 15.13	— 4.65	+ 3.04		A. N. XXXIX. 299
Bonn,	30.49715	*23 10 23.71	2 33 11.30	+ 2.29	+ 0.20		A. N. XXXIX. 299
Washington,	30.64972	*23 8 7.06	2 33 3.95	+ 3.91	+ 4.04	A. J. IV. 71	A. N. XL. 254
Hamburg,	Oct. 1.38835	22 57 21.55	2 31 42.92	—13.09	—21.70	A. J. IV. 53	A. N. XXXIX. 132
Berlin,	1.46440	*22 55 57.80	2 31 58.47	+ 5.52	— 0.35		A. N. XXXIX. 377
Bonn,	1.46703	*22 55 50.97	2 32 4.67	+ 9.99	+ 6.04		A. N. XXXIX. 299
Berlin,	2.45311	*22 41 0.58	2 30 44.21	+ 8.41	+ 1.82		A. N. XXXIX. 375
Bonn,	2.47045	*22 40 48.70	2 30 44.68	+ 4.50	+ 3.64		A. N. XXXIX. 299
Bilk,	2.49987	*22 40 25.70	2 30 42.20	+ 0.72	+ 3.26		A. N. XL. 194
Washington,	5.62246	*21 52 3.26	2 26 14.83	+ 6.17	+ 2.06	A. J. IV. 71	A. N. XL. 254
Berlin,	6.45639	21 37 27.05	2 24 46.13		— 7.84		A. N. XXXIX. 375
Berlin,	7.44271	*21 23 15.09	2 23 19.27	+ 3.62	+ 2.74		A. N. XXXIX. 375
Washington,	7.62716	*21 20 19.51	2 22 59.12	+ 2.31	+ 1.34	A. J. IV. 71	A. N. XL. 254
Berlin,	8.38088	*21 8 11.38	2 21 44.36	+ 4.12	+ 4.68		A. N. XXXIX. 375
Washington,	8.58725	*21 4 56.65	2 21 20.58	— 0.54	+ 1.78	A. J. IV. 71	A. N. XL. 254
Berlin,	9.41900	*20 51 23.17	2 19 52.96	+ 6.56	+ 5.11		A. N. XXXIX. 375
Vienna,	10.33172	20 36 37.25	2 18 4.87	+ 3.38	+ 1.16		A. N. XXXIX. 170
Berlin,	10.41022	20 35 24.49	2 17 55.73	— 0.53	+ 5.53		A. N. XXXIX. 375
Vienna,	11.32494	20 20 21.56	2 16 7.31	+ 6.21	+ 2.08		A. N. XXXIX. 170
Vienna,	13.29350	19 48 6.71	2 11 59.68	+ 4.86	+ 1.73		A. N. XXXIX. 170
Washington,	15.62333	19 9 37.06	2 6 39.28	+ 8.01	+ 2.52	A. J. IV. 71	A. N. XL. 254
Washington,	17.65080	18 36 12.61	2 1 24.54	+ 3.65	— 4.20	A. J. IV. 71	A. N. XL. 254
Washington,	19.63044	18 3 44.02	1 56 0.59	— 2.58	— 1.18	A. J. IV. 71	A. N. XL. 254
Bonn,	21.48959	17 33 24.38	1 50 37.27	+ 0.34	+ 5.96		A. N. XXXIX. 299
Washington,	21.63242	17 31 5.68	1 50 9.88	+ 1.06	+ 4.87	A. J. IV. 71	A. N. XL. 254
Bonn,	22.50026	17 17 3.98	1 47 28.62	— 6.26	+ 6.97		A. N. XXXIX. 299
Washington,	22.60569	17 15 27.51	1 47 6.16	— 5.47	+ 4.46	A. J. IV. 71	A. N. XL. 254
Bonn,	23.47870	17 1 11.77	1 44 17.54	+ 9.64	+ 5.18		A. N. XXXIX. 299
Washington,	23.63434	16 58 51.38	1 43 46.45	+ 0.78	+ 4.75	A. J. IV. 71	A. N. XL. 254
Berlin,	24.35058	16 47 24.38	1 41 25.31	+ 2.84	+ 7.59		A. N. XXXIX. 375
Washington,	24.63831	16 43 12.17	1 40 21.67	—18.79	+ 2.99	A. J. IV. 71	A. N. XL. 254
Washington,	24.63568	16 27 19.23	1 36 52.52	— 8.87	+ 3.07	A. J. IV. 71	A. N. XL. 254
Bonn,	26.52125	16 13 22.24	1 33 37.42	— 0.99	+ 0.27		A. N. XXXIX. 299
Bonn,	27.42563	15 59 22.72	1 30 17.72	— 0.28	+ 1.72		A. N. XXXIX. 299
Berlin,	27.46648	15 58 40.72	1 30 2.44	+ 4.07	— 3.37		A. N. XXXIX. 375
Göttingen,	27.51201	15 58 0.06	1 30 15.33	+ 2.69	+18.83		A. N. XXXIX. 162
Vienna,	28.28860	15 46 9.15		— 0.05			A. N. XXXIX. 170
Göttingen,	28.42762	15 44 6.87		— 3.44			A. N. XL. 242
Göttingen,	28.42836		1 26 21.29		— 4.13		A. N. XL. 242
Bonn,	28.43014	*15 44 6.69	1 26 29.67	— 5.56	+ 4.65		A. N. XXXIX. 299
Berlin,	28.44899	*15 43 48.53	1 26 19.44	— 4.55	— 0.85		A. N. XXXIX. 375
Bilk,	29.39653	*15 29 26.81	1 22 37.08	— 5.97	+ 1.17		A. N. XL. 194
Bonn,	29.45857	*15 28 31.04	1 22 23.44	— 4.57	+ 2.48		A. N. XXXIX. 299
Berlin,	29.60176	*15 26 22.57	1 21 50.58	— 4.09	+ 4.11		A. N. XXXIX. 375
Vienna,	30.28549	*15 16 13.26	1 19 3.67	— 2.19	+ 4.32		A. N. XXXIX. 170
Berlin,	30.37741	*15 14 52.00	1 18 36.99	— 1.71	+ 0.46		A. N. XXXIX. 375
Bonn,	30.42006	*15 14 14.30	1 18 29.23	— 4.61	+ 3.29		A. N. XXXIX. 299
Washington,	30.59143	15 11 43.86	1 17 47.00	+11.91	+ 3.64	A. J. IV. 71	A. N. XL. 254
Leyden,	31.33910	*15 0 47.30	1 14 37.47	— 1.05	+ 2.46		A. N. XXXIX. 219
Berlin,	31.40410	*14 59 48.80	1 14 19.07	+ 1.81	+ 0.65		A. N. XXXIX. 375
Bonn,	31.44139	*14 59 26.50	1 14 11.76	— 9.41	+ 2.87		A. N. XXXIX. 299
Washington,	31.64039	*14 56 17.20	1 13·23.35	+ 6.49	+ 5.53	A. J. IV. 71	A. N. XL. 254
Washington,	Nov. 2.60177	*14 28 25.96	1 4 45.53	+ 4.04	+ 6.15	A. J. IV. 71	A. N. XL. 254
Washington,	4.66167	*14 0 12.45	0 55 9.48	+ 5.37	+ 4.61	A. J. IV. 71	A. N. XL. 254
Washington,	5.59449	*13 47 50.60	0 50 41.41	+ 5.18	+ 6.81	A. J. IV. 71	A. N. XL. 254
Berlin,	9.33451	*13 0 57.31	— 0 31 24.21	+ 2.27	— 3 60		A. N. XXXIX. 375

Place of Observation.	M. T. Berlin.	㉛ α	δ	C. — O. Δα	Δδ	Authority.	
	d.	° ′ ″	° ′ ″	″	″		
Göttingen,	1854, Nov. 9.40274		— 0 31 18.59		+12.66		A. N. XL. 242
Göttingen,	9.40188	13 0 17.68		— 6.86			A. N. XL. 242
Berlin,	11.31677	*12 37 58.96	0 20 42.27	— 2.61	+ 2.30		A. N. XXXIX. 375
Göttingen,	11.36741	*	0 20 29.85		+ 6.93		A. N. XL. 242
Göttingen,	11.37111	*12 37 23.99		— 4.49			A. N. XL. 242
Göttingen,	12.43158	12 25 44.67	0 14 51.68	—11.10	+31.36		A. N. XL. 242
Berlin,	14.46712	*12 4 7.67	— 0 2 30.27	— 1.88	— 4.26		A. N. XXXIX. 375
Berlin,	16.30956	11 45 56.20	+ 0 8 35.71	+ 2.56	— 5.02		A. N. XXXIX. 375
Leyden,	17.42343	11 35 13.36	0 15 33.12	+25.21	— 7.20		A. N. XL. 199
Leyden,	Dec. 4.43826	* 9 58 41.13	2 17 10.93	— 4.24	+ 2.15		A. N. XL. 199
Leyden,	7.36254	* 9 53 38.21	2 40 51.70	— 4.33	+ 0.54		A. N. XL. 199
Leyden,	11.29281	9 52 8.12	3 13 48.83	—11.06	+ 6.28		A. N. XL. 199
Washington,	13.55978	* 9 53 50.73	3 33 24.58	— 5.80	+ 6.08	A. J. IV. 72	A. N. XL. 254
Washington,	14.51882	9 55 20.71	3 41 47.57	—16.00	+ 7.34	A. J. IV. 72	A. N. XL. 254
(1)Leyden	17.29425	*10 0 55.90	4 6 31.88	— 5.24	+ 6.96		A. N. XL. 199
Washington,	18.57239	*10 4 27.68	4 18 6.66	— 1.38	+ 6.75	A. J. IV. 72	A. N. XL. 254
Washington,	20.55644	10 11 11.56	4 36 40.35	— 0.80	—14.28	A. J. IV. 72	A. N. XL. 254
Vienna,	21.24725	*10 13 50.24	4 42 48.53	— 0.06	+ 1.39		A. N. XL. 195
Washington,	21.54969	*10 14 57.84	4 45 41.84	+ 6.61	— 2.74	A. J. IV. 72	A. N. XL. 254
Berlin,	23.34222	*10 23 5.42	5 2 29.78	— 7.47	— 1.90		A. N. XXXIX. 375
Leyden,	23.36344	10 23 5.45		— 1.47			A. N. XL. 199
Leyden,	23.37035		5 2 40.10		— 1.91		A. N. XL. 199
Berlin,	28.30098	10 50 29.46	5 49 59.54	— 5.87	+ 3.50		A. N. XXXIX. 375
Washington,	1855, Jan. 1.53635	*11 20 8.87	6 31 53.21	— 5.51	— 8.88	A. J. IV. 72	A. N. XL. 254
Washington,	10.53898	*11 40 41.65	8 3 56.03	— 1.21	+ 9.80	A. J. IV. 72	A. N. XL. 254
Washington,	12.56358	13 1 33.44	8 24 51.59	+20.76	+32.03	A. J. IV. 72	A. N. XL. 254
Washington,	14.56618	13 23 38.61	8 46 13.36	+20.04	+25.09	A. J. IV. 79	A. N. XL. 254
Washington,	16.55201	*13 46 57.82	9 7 53.49	— 4.66	+ 0.06	A. J. IV. 79	A. N. XL. 254
Washington,	17.53701	*13 58 42.84	9 18 29.29	— 7.43	+ 0.51	A. J. IV. 79	A. N. XL. 254
Washington,	18.53084	*14 10 38.99	9 29 11.56	— 0.55	+ 3.24	A. J. IV. 79	A. N. XL. 254
Washington,	19.55532	14 22 53.45	9 39 51.81	+25.29	+29.37	A. J. IV. 79	A. N. XL. 254
Washington,	22.52593	15 1 37.28	10 12 44.32	— 5.80	+ 6.15	A. J. IV. 79	A. N. XL. 254
Washington,	22.52593	15 1 33.03	10 12 43.47	— 1.55	+ 7.00	A. J. IV. 79	A. N. XL. 254
Washington,	Feb. 3.52937	*17 55 58.87	12 27 15.87	— 1.22	— 0.57	A. J. IV. 79	A. N. XL. 254
Washington,	10.58397	19 51 41.11	13 48 4.97	+ 4.15	+ 6.39	A. J. IV. 79	A. N. XL. 254
Washington,	17.51384	*21 55 24.09	15 9 16.30	—16.76	— 8.69	A. J. IV. 79	A. N. XLI. 47
Washington,	18.53672	*22 13 41.42	15 20 50.21	—16.38	— 5.49	A. J. IV. 79	A. N. XLI. 47
Washington,	20.54059	*22 51 1.91	15 44 10.51	—11.15	+ 4.50	A. J. IV. 79	A. N. XLI. 47
Washington,	21.54311	*23 9 55.28	15 55 58.69	— 5.89	+ 2.73	A. J. IV. 79	A. N. XLI. 47
Washington,	Mar. 25.55728	34 36 21.64	22 14 12.13	—14.40	+ 0.25	A. J. IV. 90	A. N. XLI. 47
Washington,	25.55728	34 36 14.79	22 14 10.08	— 7.55	+ 2.30	A. J. IV. 90	A. N. XLI. 47
Washington,	April 3.55149	*38 14 53.34	23 58 54.52	— 3.43	— 7.63	A. J. IV. 90	A. N. XLI. 47
Washington,	7.55804	*39 55 46.26	24 45 2.11	— 2.83	— 0.96	A. J. IV. 90	A. N. XLI. 47
Washington,	7.55831	39 55 41.49	+24 44 57.50	— 0.68	+ 3.83	A. J. IV. 90	A. N. XLI. 47

From this discussion, the following normals may be taken as representing the observations of *Euphrosyne* during its appearance in 1854 – 55 : —

M. T. Berlin.	No. of Observations.	α	δ	C. — O. Δα	Δδ
Sept. 6.0	5	27° 12′ 49″.25	— 2° 51′ 8″.41	— 2″.25	+2″.14
Oct. 4.0	17	22 17 23.88	— 2 28 39.50	+ 3.42	+2.70
Nov. 5.0	21	13 55 47.86	— 0 53 32.01	— 0.86	+4.01
Dec. 19.0	8	10 5 41.84	+ 4 22 5.20	— 2.74	+2.40
Jan. 16.0	5	13 40 29.44	+ 9 1 58.45	— 3.84	—0.35
Feb. 13.0	5	20 33 46.58	+11 16 11.90	—10.28	—1.50
April 9.0	2	40 32 35.93	+25 1 33.59	— 3.13	—1.29

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(1) 1 minute is taken from the α of this observation.

The observed places from which these normals have been derived are indicated by an asterisk in the table given above. It is my intention to compute the perturbations, and furnish more perfect elements for the next opposition. It is probable, however, that an ephemeris computed from the present elements would be sufficiently near for finding the planet on its reappearance.

J. FERGUSON.

Washington, 1855, *Aug.* 4.

ON THE ADAMS PRIZE-PROBLEM FOR 1856.

By BENJAMIN PEIRCE, LL. D.,
PERKINS PROFESSOR OF ASTRONOMY AND MATHEMATICS IN HARVARD UNIVERSITY.

1. The question of the theoretical equilibrium of *Saturn's* rings has already been discussed by me in its most general form, and although the mathematical formulæ remain unpublished, because they cannot be needed by the geometer who is equal to the higher problems of celestial mechanics, and because they have not yet received their final revision, from which I have been prevented by other matters, the principles of the investigation have been fully developed in this Journal. But the actual constitution of these rings appears to be so nearly symmetrical, that the deviation from symmetry can be safely regarded as a small quantity of the first order, of which the squares and higher powers may be neglected. With this modification, which embraces the conditions of the Adams Prize, the solution becomes simple, easily accessible to a moderate skill in geometry, and therefore of more immediate advantage to the progress of practical astronomy than the more general researches which are farther removed from the case of *Saturn*. In the following essay, therefore, the system of the rings is supposed to be very approximately concentric with *Saturn*, and symmetrically disposed along the plane of his equator. Under these conditions, the problem is not restricted in its generality by regarding the mass of *Saturn* as concentrated at its centre, which will be assumed as the origin of co-ordinates.

2. The division of the inquiry into the three cases of solid, fluid, and discontinuous, will be adopted, and the discussion will be conducted under these three heads.

On the Equilibrium of a Solid Ring.

3. The potential of the ring is, evidently, a maximum for any line, which is drawn perpendicular to its axial plane, at the point of meeting with this plane. But it is proved by Gauss that the potential of any masses cannot be an absolute maximum for a point of space which is exterior to the masses. With reference, therefore, to the axial plane, the potential must be a minimum for a point of this plane which is removed from the center by a distance which is of the same order with the inequalities of the ring. If, then,

Ω is the potential of the ring for the origin of co-ordinates, if

ϱ is the distance of the point of minimum potential from the origin,

ξ, η the rectangular coördinates in the plane of the ring of the point of minimum potential, referred to such axes fixed to the ring that the product of ξ and η does not occur in the value of Ω, the possibility of which axes is easily inferred from the common mode of reduction of the equation of the quadratic locus,

A is the value of the minimum potential,

B and C are positive constants dependent upon the constitution of the ring, and $B > C$,

$H^2 = B + C$,

$K = B - C$, so that K is quite small,

the value of Ω is

$$\Omega = A + B\,\xi^2 + C\,\eta^2$$
$$= A + \tfrac{1}{2}\,H^2\,\varrho^2 + \tfrac{1}{2}\,K\,(\xi^2 - \eta^2).$$

4. If the axes of x and y, which are fixed in space, are supposed to coincide, initially, with those of ξ and η, and if

x, y are the co-ordinates of the center of gravity of the ring,

r, φ are the polar co-ordinates of the center of gravity,

h is the distance from the center of gravity to the point of minimum potential,

α is the angle which h makes with the axis of ξ,

m is the ring's velocity of rotation, which may be assumed to be constant, at least, for several successive revolutions,

the values of ξ and η are, at any instant, t,

$$\xi = h\cos\alpha + x\cos m\,t + y\sin m\,t = h\cos\alpha + r\cos(m\,t - \varphi),$$
$$\eta = h\sin\alpha - x\sin m\,t + y\cos m\,t = h\sin\alpha - r\sin(m\,t - \varphi).$$

Hence, the forces by which the ring is impelled in directions parallel to the axes of ξ and η are, if the mass of the planet is unity,

$$D_\xi\,\Omega = 2\,B\,\xi = (H^2 + K)\,\xi,$$
$$D_y\,\Omega = 2\,C\,\eta = (H^2 - K)\,\eta\,;$$

and the corresponding forces in the directions of the axes of x and y are, if μ is the mass of the ring,

$$\begin{aligned}\mu\, D_t^2\, x = D_x\, \Omega &= (H^2 + K)\, \xi \cos m\, t - (H^2 - K)\, \eta \sin m\, t \\ &= H^2\, h \cos (m\, t + \alpha) + K\, h \cos (m\, t - \alpha) + H^2\, x \\ &\quad + K\, (x \cos 2\, m\, t + y \sin 2\, m\, t) \\ &= L \cos (m\, t + B) + H^2\, x + K\, r \cos (2\, m\, t - \varphi), \\ \mu\, D_t^2\, y = D_y\, \Omega &= (H^2 + K)\, \xi \sin m\, t + (H^2 - K)\, \eta \cos m\, t \\ &= H^2\, h \sin (m\, t + \alpha) + K\, h \sin (m\, t - \alpha) + H^2\, y \\ &\quad + K\, (x \sin 2\, m\, t - y \cos 2\, m\, t) \\ &= L \sin (m\, t + \beta) + H^2\, y + K\, r \sin (2\, m\, t - \varphi)\, ;\end{aligned}$$

in which L and β are determined by the equations

$$L \cos \beta = (H^2 + K)\, h \cos \alpha = 2\, B\, h \cos \alpha\,,$$
$$L \sin \beta = (H^2 - K)\, h \sin \alpha = 2\, C\, h \sin \alpha\,.$$

5. In the integration of the preceding equations, the terms multiplied by K may be omitted in a first approximation. With this omission, the complete integrals are, if e is the Napierian base,

$$x = M_x\, e^{H' t} + N_x\, e^{-H' t} - \frac{L}{H^2 + \mu\, m^2} \cos (m\, t + \beta),$$
$$y = M_y\, e^{H' t} + N_y\, e^{-H' t} - \frac{L}{H^2 + \mu\, m^2} \sin (m\, t + \beta)\, ;$$

in which

$$H' = \frac{H}{\sqrt{\mu}},$$

and M_x, M_y, N_x, and N_y are arbitrary constants dependent upon the initial conditions of position and motion. But the past and future permanence of the system is, obviously, inconsistent with any values of these constants which differ from zero ; so that the values of x and y become

$$x = - \frac{L}{H^2 + \mu\, m^2} \cos (m\, t + \beta)\,,$$
$$y = - \frac{L}{H^2 + \mu\, m^2} \sin (m\, t + \beta)\, ;$$

or the center of gravity of the ring moves in a circle about the center of gravity of Saturn, with an angular velocity just equal to that of the rotation of the ring.

6. Even when all the terms are retained in the differential equations, they can be satisfied by equations of the form

$$x = P \cos (m\, t + y)\,,$$
$$y = P \sin (m\, t + y)\, ;$$

in which P and y are determined by the equations

$$P\, (\mu\, m^2 + H^2 + K) \cos y = - L \cos \beta = - (H^2 + K)\, h \cos \alpha = - 2\, B\, h \cos \alpha\,,$$
$$P\, (\mu\, m^2 + H^2 - K) \sin y = - L \sin \beta = - (H^2 - K)\, h \sin \alpha = - 2\, C\, h \sin \alpha\, ;$$

$$\tan y = \frac{\mu\, m^2 + H^2 + K}{\mu\, m^2 + H^2 - K} \tan \beta = \frac{C\, \mu\, m^2 + 2\, B\, C}{B\, \mu\, m^2 + 2\, B\, C} \tan \alpha.$$

It is evident from the first approximation that additional terms cannot be introduced which are reconcilable with the permanence of the ring. *The center of gravity of the ring, therefore, describes a circle about Saturn with a uniform angular velocity of revolution equal to that of the rotation of the ring.*

This conclusion can be generalized, as in my former demonstration ; and it is easy to see, from geometrical considerations, *that the line which joins the centers of gravity of the ring and of Saturn must be normal to the level surface of the ring which passes through the center of gravity of Saturn, and that whereas this level surface is a completely re-entering surface, which includes the point of minimum potential of the axial plane, the center of gravity of the ring is in the exterior direction of the normal to the surface, and at such a distance from the surface that the centrifugal force arising from the motion of the ring may just balance the force in the direction of the normal.*

7. It only remains to prove that the conditions of motion, which are just shown to be necessary for the preservation of the solid ring, involve an element of dynamic instability. This may be readily demonstrated by a method which is so general as to embrace every case which is consistent with the idea of an actual ring. One of the conditions of permanence is that the time of the ring's rotation must be the same with that of the revolution of its center of gravity about the center of Saturn ; and another condition is that the center of Saturn must be at that point of a level surface of the ring at which the normal from the center of gravity of the ring intersects this level surface. But if the rotation of the ring is from any cause whatever somewhat accelerated, the foot of the normal will be immediately advanced beyond the center of Saturn, and the line which is normal to the level surface in the new position of the center of Saturn will not pass through the center of gravity of the ring, but will generally intersect the original normal within the level surface, and certainly not at a point which is between the center of Saturn and the center of gravity of the ring, unless the inequality of the ring should be so enormous as to reduce the ring itself to a slight appendage of its own inequality. The tendency of the ring being, then, to draw Saturn in the direction of the external normal to the level surface which passes through it, the reactive tendency of Saturn upon the ring results in a force applied to the ring in the direction of the internal normal. Since this force does not pass through the center of gravity of the ring, it tends to change the rotative velocity of the ring, and from the simple inspection of the relative position of the normals it is evident that the force is accelerative to the rotation of the ring, so that it increases the deviation from the condition of permanence, and is thereby an unstable element of this permanence. The same result in the opposite direction is obtained by the hypothesis of a slight retardation of the ring's velocity of rotation. *The conditions of the permanence of a solid ring are then, necessarily subject to an unstable element, and they are therefore unstable, so that the solid ring must be excluded from any physical theory which rests upon a firm basis.*

8. The preceding argument leads to the conclusion, that the conditions of permanence would lose the unstable element, if the two successive normals to the level surface of the ring at the center of Saturn intersected each other between the center of Saturn and the center of gravity of the ring ; that is, if the

center of curvature of the trace of the level surface upon the axial plane was between the centers of gravity of Saturn and the ring. But such a case must be regarded as wholly incompatible with the true idea of a ring, while its real type is that of a satellite protuberant in the direction of Saturn, and the present demonstration becomes, therefore, in this case, another form of Laplace's demonstration of the stability of such a position in the case of a satellite constituted like the moon of our own planet.

Second Hypothesis. — Of a Fluid Ring.

9. In the case of the fluid ring inequalities may be fairly neglected, for the immediate action of the mutual pressure of the fluid particles tends to their dispersion, or at least to their local disappearance, and to their assuming the form of curves, which will travel around the ring, and their influence will only be apparent in a perturbative influence, which may be neglected in a first approximation. In this approximation the modifying influence of the mutual attraction of the different portions of the ring may also be safely neglected.

10. The conditions of the motion of a fluid ring which is free from inequalities are, first, that the quantity of fluid is constant which flows through each section of the ring made by a plane perpendicular to the axial plane and passing through the center of Saturn; and, secondly, that each particle of the fluid has at each instant the velocity due to its position. Thus, if

μ is the section of the ring made by the plane which passes through Saturn perpendicular to the axial plane,

v is the velocity of the fluid perpendicular to this section,

r is the distance of the center of gravity of the section from the center of Saturn,

these principles give

$$\mu\, v = \text{constant} = A,$$
$$r\, v = \text{constant} = B,$$
$$\frac{\mu}{r} = \frac{A}{B}.$$

If, then,

$d\,\varphi$ is the angle of two successive planes,

$d\,m$ is the element of the volume of the ring included between the two successive planes,

these equations give

$$d\,m = r\,\mu\,d\,\varphi$$
$$\frac{d\,m}{r^2} = \frac{r\,\mu\,d\,\phi}{r^2} = \frac{A}{B}\,d\,\varphi = \text{constant};$$

so that the attractions of the opposite elements of the ring upon Saturn balance each other, and the ring has no tendency to move Saturn, neither has Saturn any tendency to give a motion of translation to the ring, or to check a translation which the ring may have received from other causes. Hence the ring will yield to the slightest foreign action, and may pass through successive normal forms of possible equilibrium without being restrained by the action of Saturn. *The fluid ring cannot then be regarded as one of real permanence without the aid of foreign support, although the action of the primary is not positively destructive to this, as it is to the solid ring.*

(*To be continued.*)

NOTICE OF ASTRONOMICAL INSTRUMENTS FOR SALE.

1. *Clock.* This is in the possession of William Hillhouse, Esq., of New Haven. It was constructed in 1852, by Dent, in his best style, and has only been running about three months. The appointments are complete, and Mr. Hillhouse offers it at $ 300, which is less than three quarters of its cost.

2. *Telescope.* The executors of the estate of the late John Jackson offer for sale the large equatorial telescope of Sharon Observatory. It was constructed by Merz and Son, of Munich, has 6.35 American inches clear aperture, and nine feet focal length. It was made to the order of George M. Justice, Esq., of Philadelphia, by whom it was received in Nov. 1846, and to whom reference may be made. For further information apply to Mrs. Jackson, at the Sharon Seminary, near Darby, Delaware County, Pennsylvania.

G.

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THE

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No. 87.

VOL. IV. CAMBRIDGE, 1855, SEPTEMBER 19. NO. 15.

COMPARISON OF STAR-PLACES GIVEN IN RUMKER'S AND THE TWELVE-YEAR CATALOGUE.

REPORT TO PROFESSOR BACHE, SUPERINTENDENT OF THE COAST-SURVEY.

BY CHARLES A. SCHOTT.

[Published by authority of the Hon. Secretary of the Treasury.]

Computing Division of the Coast-Survey, 1855, *March* 20.

THE following comparison of the places of stars as given in the Greenwich Twelve-Year Catalogue and RÜMKER's Hamburg Catalogue, is respectfully submitted.

A notice of this Catalogue, "Mean Places of 12,000 Fixed Stars for the Commencement of the Year 1836, from Observations at the Hamburg Observatory, by CHARLES RÜMKER," will be found in No. 427, 442, and 539 of the *Astronomische Nachrichten*. See also No. 38 of the *Astronomical Journal*.

The last division also contains the commencement of a new catalogue for the epoch January 1st, 1850. The constants a, b, c, d, and a', b', c', d', refer to A, B, C, D of the Nautical Almanac, and are consequently BESSEL's changed notation. The proper motions are given in a separate table at the end of each hour. The comparison between these two catalogues was made for the purpose of revising the results for latitudes determined with the Zenith Telescope, in order to introduce the most reliable places of stars. The comparison extends over each of the 24 hours of right-ascension, and includes 398 stars. The mean places for 1836, in RÜMKER's Hamburg Catalogue were reduced to the epoch 1840 of the Twelve-Year Catalogue, and the following table, which is sufficiently explained by the heading of each column, contains the difference.

Hour.	Star's Number.		No. of Obs. for α.		Difference in $\Delta\alpha$. T. Y. — R.	$\Delta\alpha\cos\delta$.	No. of Obs. for N. P. D.		Diff. in N. P. D. T. Y. — R.
	Twelve-Year.	Rümker.	T. Y.	R.			T. Y.	R.	
					s.	s.			″
0	9	14	100	20	—0.04	—0.01	50	20	—0.22
	10	23	6	2	+0.14	+0.14	4	2	—1.61
	15	42	5	2	—0.07	—0.07	10	2	+1.17
	16	52	7	2	—0.30	—0.30	6	2	—3.57
	21	75	4	3	+0.10	+0.10	8	3	+0.29
	31	122	5	12	+0.01	0.00	46	10	+1.30
	35	145					4	2	+1.97
	36	146	6	5	—0.10	—0.10	6	4	+1.66
	45	177	5	6	—0.15	—0.11	8	5	—1.21
	50	193	13	6	+0.02	+0.02	8	6	+0.48
	53	196	5	2	+0.14	+0.11	11	2	+2.12
	57	223	3	23	+0.18	+0.09	18	23	+0.86
	58	228	5	4	+0.03	+0.02	6	4	—1.26
0	66	246	10	4	—0.11	—0.11	14	4	—0.10

Hour.	Star's Number.		No. of Obs. for α		$\Delta\alpha$ T. Y. — R.	$\Delta\alpha\cos\delta$.	No. of Obs. for N. P. D.		Diff. in N. P. D. T. Y. — R.
	Twelve-Year.	Rümker.	T. Y.	R.			T. Y.	R.	
					s.	s.			″
1	106	282	4	4	+0.09	+0.03	4	4	+0.58
	107	285	3	6	+0.18	+0.09	8	6	+2.03
	124	318	6	6	—0.11	—0.11	9	6	—0.12
	137	352	5	5	—0.06	—0.06	5	3	+0.84
	139	373	5	2	—0.03	—0.03	5	2	+0.54
	145	387	2	1	—0.24	—0.21	3	1	+0.27
	147	392	4	3	—0.02	—0.01	3	3	+1.33
	152	412	4	4	—0.06	—0.06	4	4	—1.15
	163	452	6	11	+0.06	+0.05	30	12	+2.38
	170	469	7	9	—0.23	—0.22	9	8	—0.90
	174	486	3	3	—0.08	—0.03	2	3	+1.63
1	177	491	3	6	+0.27	+0.08	2	5	+0.82
2	206	593	3	3	0.00		2	3	+1.31
	223	666	2	2	+0.03	+0.03	2	2	+0.19
	226	677	7	5	—0.20	—0.19	10	5	—1.66
	227	681	3	2	—0.10	—0.09	5	2	—2.08
	230	688	5	4	+0.06	+0.06	5	4	—0.05
	235	692	56	29	—0.06	—0.06	56	28	—0.81
	237	696	1	4	0.00		3	3	—1.06
	247	726	3	5	+0.11	+0.11	5	5	+2.69
	248	727	3	3	+0.02	+0.01	3	3	+0.64
	249	746	3	3	+0.24	+0.23	5	3	+1.34
	254	762	8	4	—0.21	—0.20	13	4	—0.94
	257	769	3	3	—0.06	—0.01	4	3	—0.51
2	265	778	3	3	—0.31	—0.24	10	3	—2.84
3	271	801	11	13	—0.07	—0.07	21	12	—0.27
	275	814	6	8	—0.06	—0.06	12	7	—2.40
	282	843	3	1	—0.62	—0.58	5	1	—4.37
	286	851	1	1	—0.24	—0.23			
	292	857	8	9	+0.01	+0.01	2	8	+0.47
	293	861	3	3	—0.04	—0.04	6	3	—0.85
	294	863	3	7	+0.18	+0.12	5	5	—1.20
	296	881	7	3	0.00		5	3	—0.51
	298	891	3	2	+0.02	+0.02	4	2	—0.21
	299	892	3	14	—0.20	—0.13	2	14	—0.04
	301	910	6	2	0.00		10	2	—1.58
	304	929	3	4	—0.07	—0.06	6	4	—1.65
	305	930	3	17	—0.22	—0.15	34	13	+0.45
	322	984	66	54	+0.02	+0.02	51	45	—0.76
	334	1016	3	6	+0.02	+0.02	7	6	—0.50
	336	1034	6	7	—0.09	—0.07	3	6	+0.52
	342	1061	9	6	+0.05	+0.05	7	6	+0.48
	344	1074	15	12	—0.02	—0.02	5	13	+0.84
	345	1076	1	1	—0.28	—0.26	4	3	+0.48
3	346	1082	3	5	—0.20	—0.14			
4	355	1107	4	7	—0.07	—0.05	16	7	—0.02
	359	1137	5	3	+0.04	+0.04	7	3	+0.91
	362	1154	3	7	+0.01	+0.01	5	7	—0.07
	364	1168	5	9	0.00		7	10	—0.53
	366	1177	3	3	+0.02	+0.02	5	3	—0.23
	369	1183	5	4	—0.02	—0.02			
	370	1186	12	5	—0.13	—0.12	11	5	—0.13
	371	1190	5	2	—0.27	—0.26	6	1	+5.85
	373	1204	1	13	—0.19	—0.18	6	13	+0.19
	375	1207	2	4	+0.15	+0.14	5	3	+1.93
	378	1209	1	5	+0.08	+0.08	1	3	+1.08
	379	1218	3	4	+0.09	+0.09	10	4	+1.72
	381						6	4	+0.70
	383						7	3	+5.70
	388	1237	3	2	—0.05	—0.05	4	2	+2.51
4	396	1242	1	3	+0.07	+0.07			

Hour.	Star's Number.		No. of Obs. for α.		Δα. T. Y. — R.	Δα cos δ.	No. of Obs. for N. P. D.		Diff. in N. P. D. T. Y. — R.
	Twelve-Year.	Rümker.	T. Y.	R.	s.	s.	T. Y.	R.	″
4	405	1296	1	8	—0.02	—0.02	2	8	+2.08
	409	1318	5	14	+0.03	+0.03	10	9	+0.85
	410	1325	5	5	+0.03	+0.03	6	6	+1.48
4	411	1328	2	4	+0.10	+0.09	4	5	—1.84
5	453	1431	98	104	—0.04	—0.04	76	105	0.00
	461	1465	65	47	—0.11	—0.11	34	44	—0.28
	474	1489		5	—0.04	—0.04	3	5	+0.93
	473	1491	47	34	—0.04	—0.04	26	34	+0.23
	475	1492	5	1	+0.11	+0.11	8	1	+0.73
	478	1499	4	2	+0.31	+0.28	7	2	—0.05
	481	1524	5	11	+0.01	+0.01	2	10	+1.00
	487	1555	3	2	—0.11	—0.11	2	2	—2.18
	506	1610	6	4	0.00		4	3	—0.47
	508	1614	3	3	—0.30	—0.18	17	3	+2.32
	516	1636	1	1	+0.01	+0.01	3	1	—1.21
	527	1718	7	1	+0.30	+0.29	5	1	+0.48
5	529	1731	2	1	—0.21	—0.19	3	1	+1.35
6	534	1764	7	9	—0.13	—0.11	10	8	+0.50
	535	1766	5	4	—0.09	—0.08	5	4	+0.16
	538	1796	5	1	—0.15	—0.15	7	1	—3.33
	550	1834	62	20	—0.09	—0.08	54	20	—0.30
	560	1874	3	8	—0.04	—0.04	7	7	—0.28
	579	1940	4	10	—0.13	—0.13	5	10	—1.19
	582	1962	6	1	+0.07	+0.05	2	1	+1.24
	587	1979	14	16	+0.01	+0.01	12	13	—0.05
	604	2007	3	4	+0.14	+0.12	6	4	+0.43
6	626	2082	5	15	+0.01	+0.01	7	15	—0.52
7	638	2122	6	12	—0.05	—0.04	5	12	+1.50
	640	2125	5	3	+0.07	+0.05	5	3	—0.25
	659	2180	6	3	—0.02	—0.02	6	3	—0.12
	661	2184	67	38	+0.01	+0.01	56	37	+0.51
	663	2210	1	1	+0.18	+0.16	4	1	—1.44
	664	2215	8	14	0.00		8	14	—0.16
	672	2232	3	1	—0.17	—0.11	5	1	+0.91
	675	2239	2	2	—0.03	—0.03	5	2	+0.22
	678	2267	110	151	—0.05	—0.04	90	148	+0.58
	680	2273	5	1	+0.03	+0.03	1	1	+2.52
	692	2280	10	4	+0.11	+0.10	12	4	—0.55
	707	2314	6	6	+0.11	+0.10	4	6	+1.58
	709	2335	6	3	—0.02	—0.02	5	2	+0.91
	712	2366	5	1	—0.08	—0.08	6	1	+0.25
	716	2377	6	2	+0.07	+0.06	9	2	—0.78
	717	2393	5	2	+0.13	+0.13	6	2	+0.82
7	720	2397	5	8	+0.30	+0.11	35	7	+3.73
8	725	2422					4	1	—1.83
	732	2443	3	3	—0.12	—0.06	5	3	+0.74
	740	2457	3	7	—0.02	—0.01	8	7	+1.86
	745	2476	12	3	+0.05	+0.05	15	3	—0.75
	747	2481	4	4	+0.12	+0.09	7	4	+0.74
	751	2493	10	2	+0.25	+0.24	5	2	—3.17
	752	2511	5	2	+0.10	+0.10	5	2	—2.71
	753	2513	5	12	—0.07	—0.03	25	12	+1.57
	758	2547	6	8	—0.03	—0.03	7	7	—0.52
	760	2550					3	1	—1.13
	762	2554	11	3	+0.04	+0.04	13	3	—0.84
	768	2596	3	4	—0.07	—0.07	4	4	—0.75
	770	2609	5	2	—0.01	—0.01	5	2	—1.43
	775	2624	2	6	—0.21	—0.20	8	5	—0.87
	777	2634	12	16	—0.08	—0.08	10	15	—0.53
	781	2615	54	13	—0.03	—0.03	37	13	+0.54
8	784	2672					6	3	—1.50

Hour.	Star's Number.		No. of Obs. for α.		Δ α. T. Y. — R	Δ α cos δ.	No of Obs. for N. P. D.		Diff. in N. P. D. T. Y. — R
	Twelve-Year.	Rumker.	T. Y.	R.			T. Y.	R.	
					s.	s.			″
8	791	2703	35	44	—0.11	—0.07	56	44	+0.38
	793	2705	4	1	+0.09	+0.09	6	1	—3.03
8	797	2717	2	5	+0.01	+0.01	9	5	—0.12
9	805	2768	4	1	+0.21	+0.19	1	1	—0.50
	806	2770	3	5	—0.17	—0.08	2	5	+4.87
	810	2782	3	4	+0.12	+0.06	1	4	—0.51
	812	2786	6	6	—0.06	—0.03	21	6	+1.50
	823	2864	3	2	—0.01	0.00	2	1	+3.07
	825	2865	5	1	+0.27	+0.09	2	1	+2.57
	829	2868	26	57	+0.05	+0.03	71	57	+0.65
	831	2870	11	4	+0.01	+0.01	12	3	—0.54
	832	2871	5	3	—0.14	—0.14	2	3	—1.84
	833	2872	5	1	+0.01	+0.01	6	1	—1.35
	834	2873	3	1	—0.09	—0.05	2	1	—4.32
	840	2898	2	1	+0.16	+0.16	4	1	—2.59
	841	2913	8	16	—0.07	—0.07	12	14	—1.22
	843	2923	2	4	—0.06	—0.06	2	4	+1.49
	845	2933	74	38	—0.05	—0.05	58	38	—0.53
	847	2940	5	1	+0.27	+0.26	5	1	—0.38
	849	2948	3	2	+0.15	+0.08	82		+1.86
	851	2959	2	2	—0.11	—0.06	9	2	+1.82
	852	2976	5	18	+0.03	+0.03	6	18	+0.30
9	855	3021	6	9	—0.04	—0.01	4	7	—1.29
10	868	3104					3	5	—0.81
	869	3110	3	13	+0.03	+0.02	67	12	+2.78
	873	3133	2	19	—0.09	—0.08	2	19	—0.16
	880	3150	2	6	—0.19	—0.14	5	6	+8.30
	885	3178	5	5	+0.16	+0.16	6	5	—1.25
	887	3196					8	2	+1.26
	888	3197	1	4	+0.12	+0.09			
	893	3207	3	5	+0.37	+0.20	12	5	+1.54
	896	3233	12	33	—0.04	—0.04	17	32	+0.67
	897	3235	3	3	+0.35	+0.19	16	3	+5.59
	899	3247	5	3	—0.12	—0.12	6	3	—4.19
	904	3277					4	5	+1.95
	908	3299	10	2	—0.05	—0.05	4	2	+0.12
	914	3324	1	3	+0.10	+0.10	9	3	—0.08
	915	3334	5	1	+0.11	+0.11	5	1	+1.25
	916	3348	6	7	—0.05	—0.05	11	7	+0.08
	917	3352					9	7	+2.25
	918	3366	3	3	+0.28	+0.16	7	3	+0.37
	919	3370					2	5	—0.71
10	925	3424	5	7	—0.01	—0.01	4	7	0.00
11	937	3447	3	10	+0.04	+0.03	59	10	+0.68
	938	3481	1	3	+0.22	+0.22	1	4	—1.42
	939	3482	96	33	—0.02	—0.02	75	33	+0.01
	941	3494	2	3	+0.17	+0.16	3	3	+1.11
	942	3500	5	3	—0.02	—0.02	6	3	—0.99
	948	3535	11	31	—0.02	—0.02	10	26	+1.55
	949	3554	1	13	+0.31	+0.30	2	14	+0.27
	953	3580	1		+0.01	+0.01	5	3	—0.92
	955	3587	7	14	+0.04	+0.04	6	14	+0.54
	958	3604	3	12	—0.14	—0.05	42	11	+1.32
	959	3609	5	3	—0.07	—0.07	2	3	+1.02
	964	3659	11	17	—0.07	—0.07	13	18	—0.13
	966	3667	3	1	—0.13	—0.09	8	1	—0.76
	969	3733	4	16	—0.13	—0.09	8	9	+0.78
	970	3734	8	6	—0.02	—0.02	9	6	+0.70
	975	3748	13	8	+0.04	+0.04	13	8	+0.69
	976	3751	13	9	+0.07	+0.05	16	9	+1.52
11	983	3767	8	10	+0.01	+0.01	7	10	—1.10

Hour.	Star's Number.		No. of Obs. for α.		Δ α. T. Y. — R.	Δ α cos δ.	No. of Obs. for N. P. D.		Diff. in N. P. D. T. Y. — R.
	Twelve-Year.	Rümker.	T. Y.	R.			T. Y.	R.	
					s.	s.			″
11	984	3774	1	6	+0.18	+0.18	9	6	+0.30
11	987	3786	6	4	—0.08	—0.06	6	1	+1.30
12	998	3882	19	50	—0.12	—0.06	170	41	+1.54
	1002	3910	7	29	—0.11	—0.11	11	29	+0.36
	1005	3915	3	2	—0.11	—0.11	4	2	—2.30
	1006	3923	3	5	+0.05	+0.03	5		—0.85
	1010	3985	4	5	—0.03	—0.02	6	5	+1.00
	1017	4029	3	7	+0.08	+0.03	54	7	+1.74
	1018	4040	2	8	+0.41	+0.11	5	9	+0.39
	1029	4169	5	1	—0.07	—0.07	1	1	—2.01
	1031	4175	6	10	+0.04	+0.04	5	10	+0.16
	1032	4179	3	13	—0.12	—0.06	111	13	—0.25
	1033	4183	1	2	+0.16	+0.16	8	2	+0.02
	1037	4190	58	12	—0.13	—0.10	61	12	+0.89
12	1042	4215	3	2	—0.04	—0.02	4	1	—0.19
13	1049	4224	17	6	+0.01	+0.01	34	5	—0.81
	1052	4228	5	1	+0.18	+0.17	3	1	+6.71
	1056	4254	5	3	—0.05	—0.05	7	3	—0.86
	1070	4333	2	2	+0.08	+0.08	1	2	—0.75
	1072	4343	4	2	+0.21	+0.21	5	2	—1.22
	1075	4356	3	20	+0.06	+0.06	4	20	+1.22
	1077	4369	5	2	+0.04	+0.03	2	2	+1.07
	1080	4410	5	3	+0.10	+0.09	6	3	+1.76
	1082	4413	8	13	+0.03	+0.03	10	13	—0.23
	1085	4429	5	6	—0.04	—0.04	2	6	+0.45
	1091	4449	3	4	—0.02	—0.02	3	4	+1.57
	1095	4460	5	3	—0.05	—0.04	5	3	—1.97
	1097	4463	5	1	+0.07	+0.07	2	1	+0.38
	1102	4470	6	7	+0.08	+0.08	4	7	—1.10
	1108	4511	5	2	+0.19	+0.08	16	2	+1.79
	1109	4511	118	57	—0.09	—0.08	62	57	—0.82
13	1125	4605	11	42	+0.06	+0.02	75	42	+1.03
14	1127	4623	5	1	—0.18	—0.12	8	1	—2.31
	1129	4628	3	5	+0.11	+0.10	2	5	—0.82
	1131	4634	14	2	—0.05	—0.05	16	2	+1.87
	1138	4649	202	320	—0.09	—0.08	236	320	—0.13
	1144	4652	6	1	—0.16	—0.11	18	1	+1.25
	1151	4671	8	2	—0.07	—0.07	9	2	+2.89
	1157	4707	5	19	—0.10	—0.06	34	19	+1.03
	1161	4736	5	13	—0.03	—0.03	2	13	+1.04
	1163	4738	5	12	—0.02	—0.02	12	12	—0.03
	1168	4753	1	3	+0.09	+0.08			
	1176	4792	6	5	0.00		3	4	+2.79
	1189	4817	4	2	+0.28	+0.27	2	2	—0.77
	1201	4864	1	2	+0.11	+0.11	2	2	+1.59
	1204	4874	5	1	—0.03	—0.03	5	1	+1.84
	1210	4892	10	2	+0.11	+0.11	7	2	+0.18
	1212	4906	10	10	+0.08	+0.07	24	9	+2.13
	1213	4909	5	2	+0.05	+0.05	5	2	—0.30
	1214	4917	3	4	—0.06	—0.05	10	4	—0.99
14	1219	4929					4	3	+0.43
15	1223	4956	7	3	—0.02	—0.02	5	3	—0.61
	1225	4964	7	6	+0.11	+0.10	9	6	—0.61
	1228	4995	5	1	+0.04	+0.04	6	1	+0.46
	1232	5006	73	57	—0.04	—0.04	52	57	+0.42
	1234	5011	3	2	+0.04	+0.03	4	2	—0.30
	1238	5025	5	1	—0.04	—0.04	6	1	+0.52
	1253	5092	3	6	—0.03	—0.03			
	1258	5101	3	6	+0.03	+0.02	31	6	+1.75
	1264	5129	5	3	—0.10	—0.10	10	3	+1.02
15	1273	5136	3	7	+0.01	+0.01	3	7	+0.36

Hour.	Star's Number.		No. of Obs. for α.		$\Delta\alpha$. T. Y. — R.	$\Delta\alpha\cos\delta$.	No. of Obs. for N. P. D.		Diff. in N. P. D. T. Y. — R.
	Twelve-Year.	Rümker.	T. Y.	R.			T. Y.	R.	
					s.	s.			′
15	1276	5143	7	1	—0.17	—0.16	16	1	—0.47
	1277	5148	3	2	—0.11	—0.08	5	3	—1.01
	1279	5150	5	2	—0.01	—0.01	2	2	+0.67
	1296	5199	4	2	+0.01	+0.01	5	2	—2.22
	1298	5204	11	2	+0.10	+0.10	6	2	+5.83
	1307	5238	6	2	—0.11	—0.14	12	2	+3.03
	1309	5245	26	14	+0.22	+0.05	80	13	+1.41
	1312	5248	13	6	+0.11	+0.10	11	4	+0.07
	1311	5249	5	2	+0.06	+0.05	2	2	—0.47
15	1318	5280	51	42	—0.06	—0.06	37	42	—0.23
16	1334	5326	5	2	—0.03	—0.03	5	2	—0.03
	1335	5331	5	3	—0.09	—0.08	5	3	—0.06
	1338	5337	74	40	—0.03	—0.03	51	40	+0.75
	1345	5365	4	21	+0.12	+0.05	10	18	+1.35
	1346	5377	12	6	—0.05	—0.05	14	6	+3.65
	1349	5400	5	2	+0.34	+0.32	5	1	—3.54
	1350	5404	3	1	+0.41	+0.30	25	1	+1.36
	1358	5420	5	1	—0.07	—0.06			
	1362	5425	41	61	+0.04	+0.02	154	61	+2.05
	1368	5428	5	3	+0.16	+0.16	7	3	+1.93
	1369	5430	4	1	0.00		1	1	+1.58
	1371	5441	8	3	+0.08	+0.07	11	3	+3.41
	1374	5460	4	9	+0.10	+0.10	3	9	+0.48
	1376	5468	5	4	—0.06	—0.04	1	4	+2.96
	1386	5485	7	1	—0.09	—0.09	10	1	—2.64
	1390	5510	4	1	—0.23	—0.15	5	1	—1.85
	1392	5516	6	28	—0.04	—0.03	8	18	+1.08
	1394	5529	5	3	+0.05	+0.05	3	3	+3.65
	1396	5535	6	14	0.00		8	14	+1.05
16	1401	5546	5	2	—0.73	—0.31			
17	1442	5696	6	12	—0.07	—0.07	4	12	—0.56
	1475	5789	5	13	—0.13	—0.12	6	17	+1.71
	1478	5804	1	1	—0.07	—0.06	8	1	+1.93
	1484	5821	5	5	+0.04	+0.04	10	5	—0.39
	1489	5833	3	5	+0.10	+0.10	5	5	+0.94
	1496	5862	5	12	+0.05	+0.05	2	12	—0.09
	1500	5885	5	7	—0.06	—0.05	6	7	+0.87
	1504	5905	40	113	—0.05	—0.03	102	105	+0.44
	1511	5920	3	7	—0.14	—0.08	2	5	+0.36
	1512	5922	3	6	+0.06	+0.03	7	2	+1.70
	1514	5931	5	11	—0.26	—0.24	10	1	+2.27
	1519	5942	5	10	+0.05	+0.05	6	8	+3.59
	1518	5946	3	8	—0.02	—0.01	4	8	+3.88
	1522	5954	5	5	—0.05	—0.05	5	6	+0.52
	1525	5970	3	9	—0.09	—0.06	45	9	+0.75
	1526	5975	6	21	—0.08	—0.08	8	24	+0.05
	1527	6000	8	4	—0.01	—0.01	7	4	+2.31
	1528	6006	3	9	—0.01	—0.01	4	9	+2.97
	1532	6019	5	19	—0.13	—0.13	7	16	—0.17
17	1537	6081	2	1	—0.05	—0.03	6	1	+0.55
18	1577	6251	7	8	+0.07	+0.06	8	7	+0.08
	1578	6284	96	22	—0.01	—0.01	59	20	—0.05
	1583	6307					10	5	—0.71
	1587	6376	11	10	0.00		6	10	+3.28
	1592	6401	5	4	—0.12	—0.11	4	3	—1.67
	1594	6412	1	6	+0.03	+0.03	5	6	+2.57
	1593	6413	3	1	+0.38	+0.17	35	1	+0.74
	1596	6429	5	2	+0.10	+0.08	6	2	+0.70
	1609	6526	3	1	—0.07	—0.04	29	1	+1.03
	1614	6555	7	1	—0.32	—0.32	15	1	+0.67
18	1626	6612	5	1	—0.20	—0.18	8	1	+3.49

Hour.	Star's Number.		No. of Obs. for α.		$\Delta\alpha$. T. Y. — R.	$\Delta\alpha\cos\delta$.	No. of Obs. for N. P. D.		Diff. in N. P. D. T. Y. — R.
	Twelve-Year.	Rümker.	T. Y.	R.			T. Y.	R.	
					s.	s.			″
18	1642	6703	7	6	—0.14	—0.11	11	6	+0.53
	1643	6704					5	2	—1.17
	1645	6706					5	5	+0.55
	1648	6720	3	4	—0.26	—0.15	8	3	+0.06
	1650	6752	1	1	+0.34	+0.32			
	1655	6793	6	18	—0.02	—0.02	9	18	—0.44
	1656	6797	5	1	—0.25	—0.23	3	1	—1.48
	1659	6849					2	2	—0.29
	1662	6858	7	2	—0.25	—0.25	6	2	—3.79
18	1666	6867	4	5	—0.01	—0.01			
19	1690	7159	1	9	—0.08	—0.08	5	9	—1.37
	1695	7259	3	5	—0.04	—0.02	18	1	+0.52
	1703	7285	5	4	—0.12	—0.09	2	4	—2.02
	1704	7290	3	11	—0.02	—0.01	5	12	+1.63
	1708	7316	3	1	+0.04	+0.04	4	1	+0.18
	1712	7330	8	9	—0.10	—0.04	62	8	+0.96
	1720	7347	3	3	—0.15	—0.09	7	2	+2.37
	1728	7390	5	2	+0.14	+0.13	7	2	+1.85
	1729	7394	5	5	—0.01	—0.01	6	4	+0.29
	1730	7395	1	2	0.00				
	1733	7403	5	4	+0.01	+0.01	9	4	—0.50
	1734	7408	6	1	+0.14	+0.12	10	1	—0.87
	1736	7424	5	1	—0.26	—0.24	5	1	—1.36
	1743	7504	5	5	—0.10	—0.10	6	5	+0.30
	1745	7549	1	15	+0.04	+0.04	2	10	+0.22
	1749	7597	3	2	—0.05	—0.05	5	2	+0.09
	1756	7716	3	14	—0.11	—0.11	7	11	+0.57
	1761	7738	5	2	—0.01	—0.01	38	2	+0.34
	1762	7757	3	3	+0.03	+0.03	18	3	—1.86
19	1764	7804	3	9	—0.17	—0.17	4	7	+0.94
20	1812	8145	6	2	+0.11	+0.07	5	2	—1.17
	1817	8158	5	3	+0.03	+0.02	6	3	+0.67
	1829	8261	2	6	+0.25	+0.12	10	6	+0.70
	1830	8393					77	7	+1.12
	1846	8485	6	2	+0.39	+0.35	8	2	+2.01
	1853	8525					8	1	+1.62
	1873	8667	3	1	—0.08	—0.06	4	1	+0.59
	1874	8670	4	3	+0.06	+0.05	4	3	—0.71
	1878	8786	10	2	+0.20	+0.03	16	2	+0.36
	1880	8793	2	1	—0.08	—0.05	7	1	—0.40
	1882	8849	5	1	—0.19	—0.18	5	1	—2.26
	1886	8890					57	17	+0.07
20	1887	8890					31	3	—1.77
21	1888	8912	5	10	—0.05	—0.05	3	10	—1.19
	1889	8919	2	2	—0.08	—0.05	7	2	—0.11
	1891	9015	106	23	—0.09	—0.08	70	23	—0.57
	1892	9033	8	9	+0.02	+0.02	7	9	—0.95
	1895	9056	5	1	—0.04	—0.04	12	1	—0.41
	1894	9057	3	1	—0.25	—0.22	9	1	+4.51
	1902	9101	7	7	—0.03	—0.03	8	7	+0.10
	1907	9227	89	90	—0.07	—0.07	58	90	—1.26
	1922	9277	7	7	—0.08	—0.08	5	6	+0.10
	1923	9292	5	2	+0.02	+0.02	4	2	+0.17
	1926	9323	15	30	—0.15	—0.14	9	29	—0.49
	1930	9361	3	6	+0.21	+0.18	5	6	+0.73
	1934	9416	90	35	—0.07	—0.07	65	35	—0.60
	1935	9419	3	1	+0.12	+0.08	7	1	—0.57
	1940	9434	1	2	+0.19	+0.17	4	1	+0.12
	1941	9445	5	4	—0.04	—0.04	6	4	+0.34
	1942	9449	16	46	—0.01	—0.01	12	46	—0.92
21	1944	9479	3	2	+0.35	+0.12	5	2	—3.48

Hour	Star's Number		No. of Obs. for α		$\Delta\alpha$. T. Y. — R.	$\Delta\alpha\cos\delta$.	No. of Obs. for N. P. D.		Diff. in N. P. D. T. Y. — R.
	Twelve-Year.	Rümker.	T. Y.	R.			T. Y.	R.	
					s.	s.			″
21	1947	9509	5	3	+0.20	+0.06	10	3	+1.77
21	1954	9586	5	1	+0.28	+0.25	2	1	—3.78
22	1974	9856	9	2	—0.03	—0.03	10	2	+0.94
	1983	9885	5	2	—0.05	—0.04	10	2	—0.26
	1989	9943	1	2	—0.29	—0.28	1	2	+0.02
	1990	9953	5	14	+0.14	+0.08	21	14	+2.05
	1993	10018	15	35	—0.14	—0.14	8	35	+0.27
	1994	10031	6	3	—0.07	—0.04	43	2	+0.61
	1999	10119	13	18	0.00		7	18	+0.29
	2000	10130	5	5	—0.11	—0.10	2	5	—1.68
	2003	10165	3	1	—0.13	—0.13	4	1	—1.71
	2004	10194	5	4	+0.03	+0.03	2	4	—0.73
	2005	10201	3	2	+0.42	+0.26	5	2	+2.83
	2018	10284	13	18	—0.14	—0.14	10	18	+0.69
	2025	10343	3	3	0.00		7	3	—0.75
	2028	10461	2	1	—0.33	—0.21	8	1	—2.76
	2029	10478	3	1	+1.25	+0.38	18	1	—0.03
	2034	10501	3	1	—0.11	—0.05	2	1	+0.18
	2035	10507	116	50	—0.12	—0.12	81	50	+0.39
	2038	10525	3	9	+0.04	+0.04	5	10	—2.12
	2040	10548	3	9	+0.07	+0.06	5	8	+0.01
22	2046	10651	2	10	+0.04	+0.04	4	9	+0.50
23	2085	10898	5	5	—0.16	—0.11	14	5	—0.16
	2086	10912	7	13	+0.01	+0.01	6	12	+0.80
	2088	10962	14	14	—0.17	—0.17	14	15	+0.28
	2092	10999	4	2	—0.22	—0.22	6	2	+3.03
	2098	11147	3	8	+0.06	+0.06	5	8	+0.01
	2103	11199	7	4	+0.01	+0.01	16	4	+0.15
	2115	11418	3	4	+0.36	+0.25	5	4	+2.89
	2116	11429	3	1	—0.01	—0.01	5	1	+0.21
	2119	11447	78	24	—0.16	—0.16	58	24	—0.03
	2121	11461	38	14	—0.16	—0.04	193	14	+1.69
	2122	11480	9	7	—0.08	—0.08	3	7	+0.77
	2126	11569	6	3	—0.06	—0.03	11	3	+1.00
	2138	11830	17	12	+0.01	+0.01	11	12	+0.61
	2144	11889	7	2	—0.11	—0.14	2	2	+0.27
	2149	11929	5	3	—0.03	—0.03	1	3	+2.20
23	2153	11953	7	2	—0.12	—0.12	2	2	—0.05

Comparison of Right-Ascensions.

The total number of observations in the Greenwich Catalogue for the above 398 stars is 4113, and in the Hamburg Catalogue 3852; the average number of observations upon each star is nearly 10 for each Catalogue. The average difference in right ascension irrespective of sign is $0^s.10$, and when reduced to the equatorial value the average $\Delta\cos\delta$ becomes but $0^s.08$. The greatest difference noticed is $0^s.58$. The numbers of the positive and negative differences nearly balance.

From an extensive comparison of the Greenwich Twelve-Year Catalogue with the British-Association Catalogue, by Professor Loomis, in No. 71 of the *Astronomical Journal*, it appears that 203 stars were found in which the difference amounts to at least $0^s.15$ (in the average $0^s.28$), and there are 23 stars whose equatorial difference amounts to more than a quarter of a second (in maximo $0^s.72$).

Comparison of North Polar Distances.

The number of observations in the Greenwich and Hamburg Catalogues respectively are 5900 and 3778, or, for nearly 3 observations in the Twelve-Year Catalogue we have 2 in Rümker's Hamburg Catalogue. The average number of observations in the lesser Catalogue is nearly nine. The average difference irrespective of sign is 1″.2, and the greatest 8″.3. The north-polar distances are in the average 0″.3 smaller in Rümker's Catalogue; and the proportion of positive and negative differences is as 5 to 3.

The comparison in No. 71 contains a table of 218 stars whose difference in declination in the Twelve-Year and British Association Catalogues amounts to more than 1″.5 (in the average 2″.4), and the greatest 7″.3.

From the above comparison we can infer that Rümker's Catalogue compares more favorably than that of the British Association with the Twelve-Year Catalogue.

CONTENTS.

Report upon the Comparison of Star-Places given in Rümker's and the Twelve-Year Catalogue, by Charles A. Schott, Esq.

THE

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EXTRACT FROM A LETTER FROM THOMAS MACLEAR, ESQ. TO THE EDITOR,

Royal Observatory, *Cape of Good Hope*, 1855, *August* 3.

I HAVE the pleasure to send you herewith the resulting places of KLINKERFUES' Comet, derived from the measured differences in R. A. and P. Dist. from the stars in its path.

The measured differences were obtained by means of the 8½ foot equatorial instrument, armed with its spider-line position-micrometer. There are only two parallel spider-lines, hence the measures are alternate.

The partial measures compared with the mean of each group, evince great precision up to the time when the Comet became faint.

The list of stars numbers 84, of different magnitudes between the 6th and 12th. Since the beginning of this year each has been observed three times in R. A. and thrice in N. P. D., with the large Transit-Circle. The carpentry of the circle-room was not (at the time) complete; but, on the whole, the observations are respectable.

T. MACLEAR.

OBSERVATIONS OF KLINKERFUES' COMET,

MADE AT THE ROYAL OBSERVATORY, CAPE OF GOOD HOPE.

By THOMAS MACLEAR, Esq.

[Corrected for refraction only.]

NOTE. — It should be understood, that on those nights when no observations were made, or the numbers are scanty, the *sky* was *clouded*.

	M. T. Cape G. H.	Right Ascension of Comet.	No. Obs.	North Polar distance of Comet.	No. Obs.	No. Star.
1853.	h. m. s.	h. m. s.		° ′ ″		
Sept. 12	17 5 15.11			107 59 19.33	4	1
	17 22 56.63	10 30 56.07	4			1
13	16 39 33.03			109 28 59.60	1	2
16	17 9 6.85			112 52 31.28	5	3
	17 24 14.48	10 17 13.55	5			3
	17 36 47.34			112 53 40.58	5	3
17	16 33 23.89			113 48 37.19	5	4
	16 42 44.04	10 14 33.06	5			4
	16 59 38.04			113 49 35.19	5	4
	17 6 3.75	10 14 30.44	5			4
	17 14 18.33			113 50 13.48	5	4
	17 20 30.86	10 14 28.81	5			4
	17 26 46.40			113 50 40.07	5	4
	17 32 46.15	10 14 27.49	5			4
19	16 45 48.32	10 9 41.88	5			5
	17 0 49.15			115 30 46.20	5	5
1853.	h. m. s.	h. m. s.				
Sept. 19	17 8 25.65	10 9 39.77	5			5
20	16 35 39.48	10 7 35.01	3			6
	17 12 42.80			116° 15′ 58″.03	3	6
21	16 32 31.85			116 56 15.75	5	7
	16 41 23.74	10 5 37.05	5			7
	16 56 46.11			116 56 58.82	5	7
22	15 49 15.49	10 3 52.34	5			8
	16 18 35.40			117 34 38.87	5	8
	16 26 10.61	10 3 49.62	5			8
	16 33 25.58	10 3 49.08	5			8
	16 43 30.85			117 35 18.70	5	8
	16 49 57.74			117 35 28.55	5	8
	17 8 8.86			117 35 47.69	5	9
	17 22 15.14	10 3 45.66	9			9
23	16 7 6.33	10 2 10.73	4			10
	16 7 6.33	10 2 10.67	4			11

Sept. 13th. Clouded sky generally until the 17th.

Sept. 20th. Clouded sky.

	M. T. Cape G. H.	Right Ascension of Comet.	No. Obs	North Polar Distance of Comet.	No. Obs.	No. Star.
1853.	h. m. s.	h. m. s.		° ′ ″		
Sept. 23	16 29 26.61			118 11 9.69	5	11
	16 37 10.10	10 2 8.70	5			11
	16 41 47.41			118 11 31.87	5	11
	16 57 59.95			118 11 52.77	5	10
	17 13 39.16	10 2 6.26	5			10
	17 28 43.85			118 12 37.87	3	10
25	15 3 2.28			119 15 16.64	5	12
	15 41 32.11	9 59 13.10	5			12
	17 10 32.18			119 18 7.61	5	12
	17 18 19.02	9 59 7.46	5			12
26	16 39 18.65			119 47 46.75	5	13
	16 56 7.23	9 57 48.92	5			13
	17 11 6.63			119 48 27.57	5	13
	17 21 51.20	9 57 47.20	2			13
27	15 51 54.94			120 15 43.80	5	14
	16 14 56.98	9 56 35.87	4			14
	16 35 13.80			120 16 35.47	6	14
	17 1 13.66	9 56 33.54	5			14
	17 19 2.10			120 17 26.58	4	14
28	15 43 42.80			120 43 6.29	5	15
	16 3 31.57	9 55 25.87	5			15
	16 20 15.23			120 43 47.97	5	15
	16 36 27.70	9 55 24.22	5			15
	16 54 8.49			120 44 25.34	5	15
	17 11 41.92	9 55 22.52	4			15
29	15 39 58.65			121 9 21.39	5	16
	15 57 35.02	9 54 19.55	4			16
	16 10 33.05			121 9 54.29	5	16
	16 32 28.27			121 10 15.51	5	17
	16 40 22.39	9 54 17.73	5			17
	16 47 55.75			121 10 34.07	5	17
30	15 42 0.38	9 53 17.61	5			18
	16 0 16.50			121 34 54.44	5	18
	16 16 49.80	9 53 15.94	5			18
	16 26 1.90			121 35 24.28	5	18
	16 34 59.83	9 53 15.25	5			18
	16 43 56.56			121 35 40.01	5	18
	16 51 23.35	9 53 14.19	5			18
	16 59 40.00			121 35 55.97	5	18
	17 7 15.76	9 53 13.58	5			18
Oct. 1	16 17 40.23			121 59 31.44	5	19
	16 38 46.51	9 52 15.49	5			19
	16 51 3.86			122 0 2.67	3	19
4	16 5 27.23			123 7 23.18	5	20
	16 12 14.12	9 49 31.36	5			20
	16 22 2.92			123 7 36.16	5	20
	16 30 3.20	9 49 30.71	5			20
	16 36 52.69			123 7 49.36	5	20
	16 46 5.38	9 49 30.39	5			20
	16 52 23.15			123 8 3.42	5	20
7	15 10 1.65	9 47 3.31	5			21
	15 25 15.36			124 9 2.79	5	21
	15 33 46.96	9 47 2.52	5			21
	15 41 10.15			124 9 15.93	5	21
	15 52 2.07	9 47 1.87	10			21
	16 23 50.46			124 9 51.51	10	21
Oct. 7	16 35 4.83	9 47 0.42	10			21
	16 47 39.77			124 10 13.94	10	21
8	16 7 17.89	9 46 13.49	10			22
	16 18 48.41			124 29 38.14	10	22
	16 30 39.87	9 46 12.53	10		22	22
11	15 19 51.71			125 25 35.43	10	23
	15 33 58.21	9 43 53.11	10			23
	15 59 51.20			125 26 5.66	10	23
	16 9 24.04	9 43 51.95	10			23
	16 20 52.68			125 26 23.24	10	23
	16 33 37.70	9 43 51.06	10			23
	16 44 5.10			125 26 41.31	10	23
13	15 28 35.62	9 42 19.18	10			24
	15 45 9.23			126 2 3.42	10	24
	15 55 17.79	9 42 18.27	10			24
	16 5 31.02			126 2 19.20	10	24
	16 14 3.72	9 42 17.73	10			24
14	15 51 58.24			126 19 45.42	10	25
	16 15 35.05	9 41 30.60	8			25
	16 35 13.49			126 20 18.36	5	25
19	14 29 44.17			127 43 9.33	10	26
	14 43 5.73	9 37 27.29	1			26
21	14 22 9.58	9 35 42.07	10			27
	14 38 34.46			128 15 27.45	10	27
	14 49 38.17	9 35 41.02	10			27
	15 1 17.57			128 15 44.13	10	27
	15 14 38.80	9 35 40.12	10			27
	15 26 7.73			128 16 0.17	10	27
	15 38 25.23	9 35 39.24	10			27
	15 50 23.58			128 16 17.34	10	27
	16 0 33.34	9 35 38.26	10			27
22	15 33 11.04			128 31 54.54	10	27
	15 45 31.23	9 34 44.25	10			27
	15 57 28.39			128 32 11.40	10	27
	16 6 21.95	9 34 43.42	10			27
	16 16 24.52			128 32 24.60	10	27
23	15 47 59.62			128 47 42.37	10	28
	15 56 59.34	9 33 47.88	10			28
26	15 21 40.58			129 33 10.33	10	29
	15 36 16.90	9 30 50.89	10			29
	15 47 39.85			129 33 24.39	10	29
	15 56 57.73	9 30 49.75	10			29
	16 8 7.70			129 33 39.18	10	29
27	15 54 31.06			129 48 29.53	10	30
	16 9 59.54	9 29 46.80	10			30
	16 20 27.03			129 48 43.05	10	30
28	15 22 14.36			130 2 50.03	10	30
	15 33 40.99	9 28 43.30	10			30
	15 44 48.47			130 3 4.66	10	30
	15 55 48.48	9 28 42.21	10			30
	16 6 10.28			130 3 18.67	20	30
29	15 2 22.46			130 17 17.56	10	31
	15 34 46.04	9 27 36.97	10			31
	15 44 39.21			130 17 35.17	10	31
	15 56 0.74	9 27 36.03	10			31
	16 7 37.54			130 17 46.62	10	31

Oct. 1st. Clouded sky.

Clouded sky between the 8th and 11th of October.

Oct. 12th. Clouded.

Clouded sky and rainy weather generally between the 14th and 21st of October.

Overcast between the 23d and 26th of October.

	M. T. Cape G. H.	Right Ascension of Comet.	No. Obs.	North Polar Distance of Comet.	No. Obs.	No. Star.
1853.	h. m. s.	h. m. s.		° ′ ″		
Oct. 31	14 16 16.91			130 45 10.49	10	32
	14 30 16.44	9 25 21.48	10			32
	15 0 42.98			130 45 38.20	10	32
Nov. 1	15 14 31.31	9 24 6.22	10			33
	15 30 34.70			130 59 48.16	10	33
	15 42 15.60	9 24 4.53	10			33
	15 51 34.79			131 0 3.60	10	33
2	14 40 5.85	9 22 52.98	10			33
	14 53 14.61			131 13 13.23	10	33
	15 8 31.02	9 22 51.19	10			33
	15 21 24.58			131 13 29.11	10	33
	15 32 15.73	9 22 49.82	10			33
3	13 49 1.48	9 21 38.72	10			34
	14 4 4.13			131 26 15.95	10	34
	14 15 50.00	9 21 37.38	10			34
	14 26 34.55			131 26 28.63	10	34
	14 37 2.14	9 21 36.10	10			34
	14 51 58.10			131 26 41.89	10	34
	15 4 27.15	9 21 34.82	10			34
4	13 40 44.22	9 20 19.45	10			34
	13 54 1.15			131 39 30.24	10	34
	14 3 13.55	9 20 18.07	10			34
	14 12 5.59			131 39 41.28	10	34
	14 23 28.54	9 20 17.10	10			34
	14 34 18.46			131 39 54.01	10	34
	14 45 59.35	9 20 15.66	10			34
5	13 46 49.68	9 18 56.86	10			35
	13 58 8.24			131 52 36.68	10	35
	14 13 23.95	9 18 55.31	10			35
	14 24 24.65			131 52 50.19	10	35
	14 36 36.37	9 18 54.11	10			35
	14 49 11.62			131 53 3.78	10	35
	15 7 59.15	9 18 52.02	10			35
6	13 35 17.06	9 17 33.84	10			36
	13 51 31.50			132 5 23.58	10	36
	14 2 57.35	9 17 32.10	10			36
	14 13 34.62			132 5 36.04	10	36
	14 31 9.26	9 17 30.43	10			36
	14 39 34.79			132 5 49.84	10	36
	14 47 58.61	9 17 29.21	10			36
7	13 0 13.84	9 16 9.38	10			37
	13 16 39.16			132 17 44.34	10	37
	13 25 48.47	9 16 7.49	10			37
	13 35 17.52			132 17 54.04	10	37
	13 44 48.67	9 16 6.46	10			37
	13 57 17.23			132 18 5.66	10	37
	14 6 38.30	9 16 5.19	10			37
8	12 24 46.20			132 29 37.36	10	38
	12 34 7.77	9 14 41.34	10			38
	12 43 23.06			132 29 46.41	10	38
	12 53 20.64	9 14 40.22	10			38
	13 5 26.37			132 29 58.32	10	38
	13 19 0.75	9 14 38.58	10			38
	13 36 27.10			132 30 14.73	10	38
10	12 47 21.89			132 53 44.45	10	39
	12 58 27.99	9 11 34.19	10			39
	13 14 47.03			132 53 58.78	10	39
	13 24 55.58	9 11 32.56	10			39
	13 36 20.52			132 54 9.83	10	39
Nov. 10	13 46 16.70	9 11 31.14	10			39
	13 57 2.84			132 54 22.15	10	39
11	12 27 44.15			133 5 5.80	10	40
	12 39 45.80	9 9 58.37	10			40
	12 51 2.17			133 5 17.29	10	40
	13 2 34.19	9 9 56.97	10			40
	13 12 45.54			133 5 29.60	10	40
	13 23 36.58	9 9 55.54	10			40
	13 33 49.81			133 5 40.31	10	40
12	13 3 45.38			133 16 39.81	10	41
	13 15 40.94	9 8 16.38	10			41
	13 27 59.54			133 16 52.36	10	41
	13 39 37.56	9 8 14.70	10			41
	13 51 55.76			133 17 4.84	10	41
13	13 21 40.65	9 6 34.07	10			42
	13 32 29.49			133 27 50.25	10	42
	13 40 59.61	9 6 32.76	10			42
	13 48 50.62			133 27 58.03	10	42
	13 56 44.53	9 6 31.48	10			42
15	13 41 6.21			133 48 54.61	10	43
	13 52 26.47	9 3 0.29	10			43
	14 2 55.36			133 49 0.07	10	43
	14 15 35.10	9 2 58.20	10			43
	14 23 40.88			133 49 12.12	10	43
16	11 40 1.23			133 57 57.19	10	44
	11 54 39.63	9 1 18.71	10			44
	12 6 16.92			133 58 6.73	10	44
	12 18 46.68	9 1 16.63	10			44
	12 31 18.31			133 58 18.75	10	44
17	12 14 1.35			134 7 47.16	10	45
	12 27 49.69	8 59 23.67	10			45
	12 39 13.52			134 7 59.20	10	45
	12 54 35.62	8 59 21.70	10			45
	13 6 55.99			134 8 11.14	10	45
18	12 13 55.33	8 57 29.76	10			46
	12 25 31.23			134 17 8.28	10	46
	12 37 17.10	8 57 27.73	10			46
	12 49 14.75			134 17 16.80	10	46
	13 0 59.33	8 57 26.05	10			46
	13 14 41.98			134 17 26.68	10	46
	13 24 16.52	8 57 23.92	10			46
19	12 8 24.89	8 55 32.66	10			47
	12 20 20.55			134 25 56.63	10	47
	12 33 9.26	8 55 30.56	10			47
	12 42 6.00			134 26 6.05	10	47
	12 51 59.58	8 55 28.79	10			47
	13 2 42.23			134 26 16.01	10	47
	13 15 7.70	8 55 26.86	10			47
20	13 11 44.83			134 34 47.19	10	48
	13 27 44.91	8 53 25.46	10			48
	13 40 1.22			134 34 59.54	10	48
	13 53 43.67	8 53 23.07	10			48
	14 7 12.37			134 35 7.81	10	48
22	11 37 47.82	8 49 27.02	10			49
	11 49 39.39			134 50 6.76	10	49
	12 1 35.05	8 49 21.60	10			49
	12 15 46.93			134 50 14.97	10	49
	12 28 14.30	8 49 22.20	10			49
	12 41 10.48			134 50 23.14	10	49

Oct. 30th. Fog and rain.

Nov. 9th. Overcast.

	M. T. Cape G. H.	Right Ascension of Comet.	No. Obs.	North Polar Distance of Comet.	No. Obs.	No. Star.
1853.	h. m. s.	h. m. s.		° ′ ″		
Nov. 22	12 52 49.68	8 49 19.83	10			49
24	11 52 53.38			135 4 13.09	10	50
	12 6 27.78	8 45 5.56	10			50
	12 16 54.09			135 4 19.12	10	50
	12 28 30.60	8 45 3.74	10			50
	12 40 22.77			135 4 27.44	10	50
	12 52 17.24	8 45 1.57	10			50
	13 5 45.56			135 4 34.19	10	50
	13 17 4.22	8 44 59.51	10			50
25	12 14 55.08			135 10 38.10	10	51
	12 27 3.31	8 42 51.30	10			51
	12 38 13.31			135 10 47.28	10	51
	12 49 53.32	8 42 48.79	10			51
	13 2 26.09			135 10 52.59	10	51
	13 13 3.48	8 42 46.76	10			51
	13 25 9.31			135 11 1.19	10	51
26	11 51 45.78	8 40 38.90	10			52
	12 5 36.84			135 16 29.58	10	52
	12 18 56.98	8 40 36.21	10			52
	12 35 1.68			135 16 35.04	10	52
	12 48 32.19	8 40 33.69	10			52
	13 3 6.34			135 16 42.79	10	52
	13 16 0.54	8 40 30.82	10			52
28	12 10 21.76	8 36 0.56	10			53
	12 23 23.35			135 26 50.87	10	53
	12 37 5.93	8 35 57.73	10			53
	12 49 35.49			135 26 57.95	10	53
	13 2 29.81	8 35 55.11	10			53
29	12 0 35.76	8 33 39.27	10			54
	12 13 42.93			135 31 12.01	10	54
	12 25 25.93	8 33 36.87	10			54
	12 37 59.99			135 31 16.24	10	54
	12 51 45.66	8 33 34.28	10			54
	13 11 18.49			135 31 22.23	10	54
	13 26 13.47	8 33 30.86	10			54
30	11 37 26.82	8 31 18.03	10			55
	11 50 16.94			135 34 57.26	10	55
	12 4 7.59	8 31 15.16	10			55
	12 14 59.53			135 35 0.80	10	55
	12 27 7.06	8 31 12.77	10			55
	12 39 40.72			135 35 4.35	10	55
	12 50 48.51	8 31 10.41	10			55
Dec. 1	11 45 0.75	8 28 51.02	10			56
	12 23 43.06			135 38 20.71	10	56
	12 38 16.67	8 28 46.36	10			56
	12 54 33.54			135 38 22.60	10	56
	13 5 45.72	8 28 42.86	10			56
	13 17 39.08			135 38 27.51	10	56
	13 31 42.68	8 28 40.10	10			56
2	11 39 41.27	8 26 23.90	10			57
	11 51 53.19			135 41 1.56	10	57
	12 2 36.45	8 26 21.47	10			57
	12 20 31.33			135 41 3.19	10	57
	12 31 36.62	8 26 18.54	10			57
	12 44 16.86			135 41 4.88	10	57
	12 55 56.55	8 26 15.89	10			57
4	11 5 4.11	8 21 27.03	10			58
	11 15 31.31			135 44 46.68	10	58
	11 27 17.60	8 21 24.60	10			58
Dec. 4	11 36 53.24			135 44 49.99	10	58
	11 58 45.89	8 21 21.23	10			58
	12 9 39.52			135 44 47.86	10	58
	12 21 52.53	8 21 18.85	10			58
5	11 46 58.82			135 45 46.20	10	59
	12 1 10.42	8 18 48.93	10			59
	12 17 21.69			135 45 48.71	10	59
	12 47 19.43	8 18 43.76	10			59
	13 13 37.97			135 45 49.96	10	59
	13 44 15.01	8 18 37.44	10			59
6	11 57 44.09			135 46 10.82	10	60
	12 10 6.80	8 16 14.23	10			60
	12 25 48.85			135 46 10.28	10	60
	12 38 53.23	8 16 10.86	10			60
	12 54 49.45			135 46 11.14	10	60
	13 14 14.19	8 16 6.64	10			60
7	11 8 53.34			135 46 2.16	10	61
	11 24 27.02	8 13 43.07	10			61
	11 41 11.59			135 46 0.12	10	61
8	11 30 35.48	8 11 6.15	10			62
	11 43 53.21			135 45 10.37	10	62
	11 59 32.06	8 11 3.23	10			62
	12 12 4.22			135 45 11.88	10	62
	12 32 5.55	8 10 59.47	10			62
	12 44 18.86			135 45 10.36	10	62
	12 55 48.58	8 10 56.52	10			62
10	12 40 29.57			135 41 35.87	6	63
	13 9 14.57	8 5 39.95	10			63
	13 29 1.75			135 41 31.99	10	63
	13 44 44.98	8 5 36.33	10			63
	14 8 32.10			135 41 28.85	10	63
11	11 44 59.67			135 39 1.85	10	64
	11 58 2.74	8 3 10.25	10			64
	12 11 57.49			135 38 58.60	10	64
	12 22 32.57	8 3 6.84	10			64
	12 35 34.96			135 38 55.26	10	64
12	10 43 15.31			135 35 53.23	10	65
	11 1 7.20	8 0 38.08	10			65
	11 15 7.22			135 35 50.12	10	65
	11 33 1.91	8 0 34.70	10			65
	12 2 3.65			135 35 41.79	10	65
17	10 20 21.09			135 9 59.48	10	66
	10 35 50.86	7 47 22.97	10			66
	10 48 17.85			135 9 52.37	10	66
	11 11 57.30	7 47 18.79	10			66
	11 27 30.07			135 9 42.91	10	66
18	8 53 53.13			135 3 20.98	10	67
	9 8 52.88	7 44 53.87	10			67
	9 22 27.97			135 3 12.36	10	67
	9 36 31.98	7 44 50.41	10			67
	9 51 50.50			135 3 0.10	10	67
	10 5 58.29	7 44 47.29	10			67
	10 20 21.75			135 2 52.33	10	67
19	9 12 38.87			134 55 29.22	10	68
	9 27 18.97	7 42 13.28	10			68
	9 41 25.06			134 55 23.54	10	68
	9 57 49.97	7 42 10.04	10			68
	10 13 37.90			134 55 11.69	10	68
	10 26 56.22	7 42 6.77	10			68

Nov. 23d. Rainy weather.

Dec. 3d. Clouded sky.

Dec. 9th. Hazy sky.

Clouded sky and rainy weather between Dec. 12th and 17th.

1853.	M. T. Cape G. H.	Right Ascension of Comet.	No. Obs.	North Polar Distance of Comet.	No. Obs.	No. Star.
	h. m. s.	h. m. s.		° ′ ″		
Dec. 20	8 54 26.86	7 39 39.51	10			69
	9 9 33.70			134 47 11.82	10	69
	10 22 27.71	7 39 30.00	10			69
	10 35 48.03			134 46 34.77	10	69
	10 51 14.81	7 39 27.01	10			69
	11 5 9.55			134 46 31.64	10	69
	11 21 9.64	7 39 23.16	10			69
	11 33 5.78			134 46 19.74	10	69
22	9 46 1.52	7 34 21.78	10			70
	10 0 13.00			134 28 18.65	10	70
	10 18 9.87	7 34 18.14	10			70
	10 32 4.29			134 28 4.48	10	70
	10 45 8.85	7 34 14.93	10			70
	10 59 9.66			134 27 55.52	10	70
	11 9 58.61	7 34 12.32	10			70
23	9 46 29.50			134 18 9.72	10	71
	10 2 47.65	7 31 41.82	10			71
	10 10 16.56			134 17 59.14	10	71
	10 21 13.93	7 31 43.15	10			71
	10 35 41.07			134 17 50.44	10	71
24	9 45 32.92			134 7 22.08	10	72
	9 59 27.66	7 29 12.42	10			72
	10 13 42.44			134 7 13.85	10	72
	10 26 35.34	7 29 9.02	10			72
	10 41 30.71			134 7 3.84	10	72
25	10 39 15.80			133 55 37.75	10	73
	10 53 25.00	7 26 34.69	10			73
	11 8 45.19			133 55 23.95	10	73
	11 20 52.91	7 26 31.70	10			73
	11 49 20.16			133 55 5.77	10	73
26	9 25 4.12			133 44 18.68	10	74
	9 42 53.61	7 24 12.16	10			74
	9 55 35.54			133 43 59.66	10	74
	10 14 13.61	7 24 8.74	10			74
	10 28 24.19			133 43 45.61	10	74
28	9 47 56.83	7 19 16.09	10			75
	10 4 32.53			133 18 15.28	10	75
	10 17 39.48	7 19 13.06	10			75
	10 32 41.64			133 17 58.08	10	75
	10 52 14.75	7 19 9.47	10			75
Dec. 29	10 6 18.08	7 16 49.85	10		10	76
	10 15 58.50			133 4 24.28		76
Dec. 29	10 25 11.44	7 16 47.97	10			76
	10 35 23.47			133 4 11.80	10	76
	10 45 42.98	7 16 45.69	10			76
30	9 31 8.22			132 50 42.87	10	77
	9 42 30.88	7 14 29.35	10			77
	9 51 21.65			132 50 24.38	10	77
	10 50 25.54	7 14 22.74	10			77
31	9 7 38.81			132 36 15.45	10	78
	9 23 11.98	7 12 11.01	10			78
	9 39 15.69			132 35 53.25	10	78
	9 51 22.02	7 12 8.24	10			78
	10 16 8.00			132 35 31.08	10	78
Jan. 1	9 59 2.77	7 9 48.85	10			79
	10 11 25.96			132 20 17.73	10	79
	10 22 41.83	7 9 46.90	10			79
	10 36 47.74			132 20 5.28	10	79
	10 50 59.53	7 9 43.80	10			79
2	10 1 47.56			132 4 43.79	10	80
	10 21 9.92	7 7 30.90	10			80
	10 37 27.87			132 4 21.68	10	80
	10 54 56.62	7 7 27.64	10			80
	11 26 48.45			132 3 50.85	10	80
4	9 21 5.18	7 3 12.28	10			81
	9 34 38.67			131 32 7.96	10	81
	9 47 6.63	7 3 9.75	10			81
	9 58 23.10			131 31 52.05	10	81
	10 17 7.83	7 3 6.81	10			81
7	12 36 33.09	6 56 37.83	10			82
	13 1 28.53			130 37 8.89	10	82
	13 18 21.98	6 56 34.33	10			82
	13 32 56.70			130 36 44.61	10	82
	13 46 42.55	6 56 32.33	10			82
8	9 10 2.23	6 54 55.37	10			83
	9 23 21.25			130 21 35.19	10	83
	9 36 53.46	6 54 52.70	10			83
	9 58 36.91			130 21 14.02	10	83
	10 18 6.34	6 54 49.45	10			83
9	14 22 12.62			129 59 5.54	10	84
	14 44 43.26	6 52 30.38	10			84
	15 0 47.65			129 58 33.67	10	84
	15 19 37.02	6 52 27.56	10			84
	15 37 55.72			129 58 6.39	10	84

Dec. 27th. Sky covered.

Rainy and cloudy weather between the 4th and 7th of January.

Jan. 3d. Rain, sky covered.

PLANET-CIRCULAR.

A new planet was discovered by Mr. H. Goldschmidt, in Paris, on the 5th instant.

Mr. Goldschmidt has sent me the following positions : —

1855.	Paris M. T.	㉟ α	㊱ δ
	h. m.	h. m. s.	° ′
Oct. 5	5 0	23 1 19	—7 49
6	7 55	23 0 26	7 40
7	7 30	22 59 34	7 33
8	7 15	22 58 42	—7 28

The star of comparison on the 8th was Lalande 45120. $\Delta\alpha$ Planet — $\ast = + 1^{m.}\ 48^{s.}$. The declinations were the same. Mr. Goldschmidt estimates the planet as being of the 11.12 magnitude.

B. A. GOULD, Jr.

Paris, 1855, *Oct.* 10.

EPHEMERIS OF EUPHROSYNE,

COMPUTED FROM THE ELEMENTS, ASTRONOMICAL JOURNAL, NO. 86.

By JAMES FERGUSON.

M. T. Berlin.	α	δ	Log △	M. T. Berlin.	α	δ	Log △
1855.	h. m s.	° ′ ″		1855.	h. m. s.	° ′ ″	
Sept. 5	8 12 36.5	+40 20 10.7	0.479278	Oct. 22	9 54 56.2	+39 30 12.7	
6	14 57.9	40 19 42.4		23	56 49.4	39 29 26.5	0.411821
7	17 19.0	40 19 10.2		24	9 58 44.0	39 28 43.5	
8	19 39.9	40 18 33.6		25	10 0 38.1	39 28 6.0	
9	22 0.6	40 17 54.8	0.474560	26	2 31.2	39 27 31.1	
10	24 20.7	40 17 13.0		27	4 23.9	39 26 59.6	0.405178
11	26 40.5	40 16 27.7		28	6 15.5	39 26 31.7	
12	28 59.9	40 15 38.9		29	8 6.3	39 26 7.9	
13	31 19.1	40 14 47.6	0.469664	30	9 56.3	39 25 47.1	
14	33 37.6	40 13 55.6		31	11 45.1	39 25 31.5	0.398392
15	35 55.7	40 13 1.5		Nov. 1	13 33.2	39 25 21.0	
16	38 13.4	40 12 5.0		2	15 20.4	39 25 15.3	
17	40 30.7	40 11 6.2	0.464621	3	17 17.3	39 25 14.2	
18	42 47.5	40 10 7.7		4	18 52.9	39 25 17.7	0.391471
19	45 3.9	40 9 6.5		5	20 37.5	39 25 28.9	
20	47 19.9	40 8 2.5		6	22 21.2	39 25 45.9	
21	49 35.6	40 6 55.7	0.459403	7	24 3.9	39 26 6.5	
22	51 50.7	40 5 45.7		8	25 45.7	39 26 29.1	0.385419
23	54 5.0	40 4 32.4		9	27 26.5	39 27 1.6	
24	56 18.9	40 3 16.3		10	29 6.2	39 27 40.2	
25	8 58 32.5	40 1 56.7	0.454026	11	30 44.9	39 28 24.6	
26	9 0 45.6	40 0 42.4		12	32 22.6	39 29 15.3	0.377257
27	2 57.9	39 59 27.4		13	33 59.3	39 30 12.6	
28	5 9.9	39 58 11.2		14	35 34.9	39 31 14.6	
29	7 21.4	39 56 53.5	0.448482	15	37 9.4	39 32 27.5	
30	9 32.2	39 55 34.9		16	38 42.7	39 33 44.5	0.369993
Oct. 1	11 42.5	39 51 16.3		17	40 15.1	39 35 9.1	
2	13 52.3	39 52 57.7		18	41 46.3	39 36 41.2	
3	16 1.6	39 51 39.8	0.442775	19	43 16.5	39 38 20.3	
4	18 10.1	39 50 22 3		20	44 45.8	39 40 7.0	0.362648
5	20 17.9	39 48 4.8		21	46 12.2	39 42 0.7	
6	22 25.3	39 47 47.3		22	47 39.4	39 44 2.1	
7	24 32.3	39 46 29.8	0.436902	23	49 4.6	39 46 11.1	
8	26 38.4	39 45 13.1		24	50 28.9	39 48 28.1	0.355241
9	28 44.0	39 43 57.8		25	51 51.6	39 50 53.5	
10	30 48.8	39 42 43.9		26	53 12.9	39 53 26.4	
11	32 53.2	39 41 30.4	0.430867	27	54 33.4	39 56 7.4	
12	34 56.6	39 40 18.3		28	55 32.6	39 58 56.2	0.347783
13	36 59.2	39 39 8.1		29	57 10.2	40 1 54.1	
14	39 1.2	39 37 59.9		30	58 26.5	40 5 1.8	
15	41 3.7	39 36 54.2	0.424667	Dec. 1	10 59 40.6	40 8 17.1	
16	43 4.5	39 35 49.5		2	11 0 54.0	40 11 40.3	0.340301
17	45 4.5	39 31 47.2		3	2 6.3	40 15 12.8	
18	47 4.2	39 33 46.5		4	3 17.4	40 18 54.2	
19	49 2.5	39 32 49.2	0.418331	5	4 27.3	40 22 43.8	
20	50 57.8	39 31 53.9		6	11 5 35.3	+40 26 42.8	0.332821
21	9 52 52.4	+39 31 1.7					

	1855.	$\Delta\alpha$	$\Delta\delta$
The correction to be applied to this ephemeris,	Sept. 17, was	—$1^{m.}$ $7^{s.}.1$	+3′ 34″.1

OBSERVATIONS OF CIRCE, MASSALIA, AND EUPHROSYNE,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By JAMES FERGUSON.

[Communicated by Lieutenant MAURY. — Corrected for refraction.]

CIRCE.

Date.		M. T. Washington.	No. of Comp.	Comparison-Star.	㉞ — *		㉞'s apparent	
					Δα	*Δδ*	*α*	*δ*
1855.		h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
May	9	11 31 6.1	8	Weisse XIII. 235	+1 33.62	— 6 36.05	13 16 16.17	—4 0 58.11
	10	9 43 41.7	11	" 235	+1 6.97	— 2 47.73	13 15 49.51	3 57 9.76
		10 23 7.8	5	B. A. C. 4477	—0 1.28	+13 6.38	13 15 48.41	3 56 56.61
	11	8 35 10.2	10	Weisse XIII. 235	+0 41.13	+ 0 57.86	13 15 23.67	3 53 24.14
	17	10 19 17.9	4	" 225	—0 54.29	—12 39.34	13 13 7.98	3 33 15.20
	20	9 10 55.2	5	" 225	—1 43.58	— 2 5.14	13 12 18.53	3 22 41.52
June	9	10 33 13.6	4	" 225	—1 23.86	+ 1 15.18	13 12 38.09	—3 19 20.05

The first four comparisons have been already published, *Astronomical Journal*, No. 84. Those of May 20 and June 9 are not satisfactory, the planet being seen with difficulty.

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	*α*	*δ*	Authority.
		h. m. s.	° ′ ″	
Weisse XIII. 235	8	13 14 56.63	—3 55 47.04	Weisse's Cat. and Rümker's Cat.
B. A. C. 4477	6	13 16 3.80	4 11 27.75	B. A. Cat. and Rümker's Cat.
Weisse XIII. 225	9	13 14 16.21	—3 22 2.77	Weisse's Cat.

MASSALIA.

Date.		M. T. Washington.	No. of Comp.	Comparison-Star.	⑳ — *		⑳'s apparent	
					Δα	*Δδ*	*Δα*	*Δδ*
1855.		h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
July	14	11 36 7.9	2	B. A. C. 6507	—0 45.50	+ 9 43.41	18 55 16.59	—21 47 22.87
			2	Arg. Z. 224, 122	—3 30.52	2 43.36	18 55 17.30	21 47 27.27
	15	10 26 18.3	10	B. A. C. 6507	—1 41.61	8 21.89	18 54 20.49	21 48 41.62
	16	9 25 47.0	8	B. A. C. 6507	—2 38.72	7 7.45	18 53 23.39	21 49 59.30
	17	9 0 34.6	10	Arg. Z. 224, 110	+1 28.44	10 9.30	18 52 25.77	21 51 13.76
	29	9 47 37.4	7	" 224, 101	—1 40.87	0 30.51	18 41 47.73	22 4 50.97
	31	9 22 58.2	14	" 224, 96	+0 31.35	+ 7 35.75	18 40 18.07	—22 6 36.89

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	*α*	*δ*	Authority.
		h. m. s.	° ′ ″	
B. A. C. 6507	4.5	18 56 17.36	—21 56 33.43	B. A. Cat. and Rümker's Cat.
Arg. Z. 224, 122	9	18 59 3.08	21 49 36.79	Argelander's Zones.
" 224, 110	7	18 51 12.67	22 0 51.31	
" 224, 101	7.8	18 43 43.87	22 4 49.71	
" 224, 96	9	18 40 2.05	—22 13 40.81	

EUPHROSYNE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉛ — * Δα	㉛ — * Δδ	㉛'s apparent α	㉛'s apparent δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Sept. 8	15 41 50.2	8	B. Z. 452, 126	+1 29.57	—3 52.09	8 20 37.60	+40 20 37.39
	15 55 14.2	3	" 452, 124	3 29.47	—0 51.41	8 20 38.80	40 20 38.56
		3	" 452, 125	2 29.41	+1 59.98	8 20 38.79	40 20 36.21
17	15 44 34.9	3	" 450, 12	2 51.13	+6 22.63	8 41 25.32	40 13 40.47
	16 6 35.2	10	" 450, 14	+0 54.58	+6 31.25	8 41 27.54	+40 13 46.76

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 452, 126	8	8 19 27.09	+40 23 45.23	Bessel's Zones.
" 452, 124	7	8 17 28.41	40 20 46.40	Radcliffe Observations.
" 452, 125	8	8 18 28.44	40 17 52.31	" "
" 450, 12	8.9	8 38 52.73	40 6 28.98	Bessel's Zones.
" 450, 14	9	8 40 51.47	+40 6 26.02	" "

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EPHEMERIS OF EGERIA FOR 1855-56.

BY PROFESSOR J. S. HUBBARD,
OF THE WASHINGTON OBSERVATORY.

BEFORE computing the ephemeris of *Egeria* given below, I compared the observations of this planet made by Mr. FERGUSON in 1854–55[1] with an ephemeris of which the one given in No. 72 of this Journal is an approximate copy. The reduced observations and the result of comparison are as follows : —

Date. M. T. Berlin.	α	δ	C. — O. $\Delta\alpha$	C. — O. $\Delta\delta$
d.	° ′ ″	° ′ ″	″	″
1854, Sept. 1.70125	28 13 5.0	—2 56 39.1	+ 30.8	+13.6
2.71803	28 8 43.9	2 57 50.3	35.6	14.4
.76886	28 8 36.1	2 57 51.1	29.9	11.5
.80600	28 8 23.3	2 57 53.9	32.8	11.6
6.92153	27 46 47.7	3 3 20.6	20.4	15.1
16.73938	26 26 42.2	3 19 4.1	33.2	15.3
17.69885	26 16 56.4	3 20 41.8	28.5	13.7
21.69908	25 32 14.8	3 27 36.4	30.4	14.5
Oct. 7.68928	21 47 18.4	3 49 8.8	24.6	17.9
8.61227	21 32 46.0	3 49 45.5	21.9	15.6
15.66017	19 39 39.4	3 51 28.3	33.8	10.6
17.68274	19 7 11.7	3 50 50.1	29.6	11.5
20.58717	18 21 0.4	—3 48 51.3	24.0	10.0
Dec. 14.56348	11 43 22.2	+0 49 43.1	16.0	7.1
.60333	11 43 34.1	0 50 1.3	12.6	9.6
20.59990	12 11 2.9	1 42 42.5	(35.1)	9.3
.59990	12 11 18.6	1 42 41.6	19.4	10.2
21.60675	12 17 6.8	1 51 49.6	27.6	10.2
.60675	12 17 14.3	1 51 51.0	20.2	8.8
(2) 1855, Jan. 10.62793	15 22 18.0	5 7 22.6	25.9	9.5
12.59667	15 46 43.9	5 27 42.3	22.6	13.6
16.59608	16 39 20.4	6 9 45.0	19.2	7.8
(3) 18.57647	17 6 50.4	6 30 43.3	17.3	10.0
19.55938	17 20 54.1	6 41 16.3	12.1	5.7
Feb. 3.57608	21 20 15.6	+9 24 39.9	+20.6	+18.9

This series of observations divides itself into two groups separated by an interval of nearly two months. The arithmetical mean of the residuals in each group, applied in the usual manner to the ephemeris, furnished the following two normals, to be added to those previously obtained : —

Date. M. T. Berlin.	α	δ	C. — O. $\Delta\alpha$	C. — O. $\Delta\delta$
d.	° ′ ″	° ′ ″	″	″
1854, Sept. 22.0	25 28 40.8	—3 28 6.2	+29.1	+13.5
Dec. 31.0	13 29 2.1	+3 20 34.6	+19.4	+10.1

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(1) *Astronomical Journal*, Vol. IV. p. 70.

(2) *Ibid.*, Jan. 10, for 5° 9′ 20″.49, read 5° 7′ 20″.49.

(3) *Ibid.*, Jan. 18, for $1^{h.}\ 8^{m.}\ 37^{s.}.24$, read $1^{h.}\ 8^{m.}\ 27^{s.}.24$.

Continuing the computation of perturbations, I have obtained the following extension of the tables already given, — the unit of δr and δz being still in the seventh decimal place.

Date.	δr	δu	δz
1855, Mar. 21	— 314	—974″.39	+3811
Apr. 30	9656	969.00	2628
June 9	19084	933.32	+1337
July 19	28160	864.43	— 22
Aug. 28	36125	763.68	1405
Oct. 7	43439	634.41	2764
Nov. 16	—48818	—482.16	—4048
1855, Dec. 26	—52285	—314″.65	—5212
1856, Feb. 4	53685	—140.51	6214
Mar. 15	53001	+ 31.52	7021
Apr. 24	50341	193.50	7610
June 3	45915	338.86	7967
July 13	—40001	+462.90	—8088

These values, computed with the still unvaried elements, are only approximate, but accurate enough for the purpose of finding the planet. Their variations since the commencement of the year are sufficient to account for the difference between the following ephemeris and that given in the *British Nautical Almanac* for 1858. I have commenced a new and more accurate computation of perturbations from the epoch of the planet's discovery, with the view of obtaining still further corrections of elements; this, if completed in time, may lead to a closer prediction of places for the coming opposition.

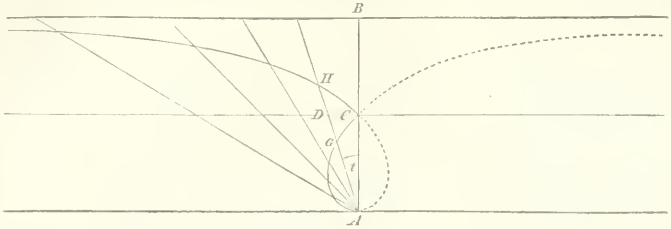
M. Noon Berlin.	⑬ α	⑬ δ	Log △
	h. m. s.	° ′	
1855, Nov. 16	10 28 27	+28 14.0	0.3450
20	34 12	28 11.5	0.3357
24	39 42	28 10.7	0.3263
28	44 56	28 12.0	0.3168
Dec. 2	49 52	28 15.5	0.3070
6	54 29	28 21.3	0.2972
10	10 58 46	28 29.7	0.2873
14	11 2 42	28 40.7	0.2773
18	6 14	28 54.4	0.2673
22	9 21	29 10.8	0.2573
26	12 2	29 29.9	0.2474
30	14 16	29 51.6	0.2377
1856, Jan. 3	16 0	30 15.8	0.2281
7	17 12	30 42.4	0.2189
11	17 51	31 11.2	0.2100
15	17 56	31 41.7	0.2017
19	17 27	32 13.5	0.1938
23	16 22	32 46.0	0.1867
27	14 43	33 18.7	0.1802
31	12 29	33 50.7	0.1746
Feb. 4	11 9 42	+34 21.4	0.1700
1856, Feb. 8	11 6 25	+34 49.9	0.1663
12	11 2 41	35 15.3	0.1637
16	10 58 36	35 36.9	0.1623
20	54 14	35 54.3	0.1619
24	49 42	36 6.6	0.1628
28	45 5	36 13.5	0.1648
Mar. 3	40 30	36 14.8	0.1680
7	36 4	36 10.3	0.1722
11	31 52	36 0.3	0.1774
15	28 0	35 44.9	0.1835
19	24 32	35 24.2	0.1904
23	21 32	34 58.5	0.1981
27	19 1	34 28.8	0.2065
31	17 0	33 55.4	0.2154
Apr. 4	15 31	33 18.6	0.2247
8	14 34	32 38.9	0.2344
12	14 7	31 56.7	0.2444
16	14 11	31 12.3	0.2546
20	14 44	30 26.1	0.2649
24	15 44	29 38.5	0.2754
28	10 17 9	+28 49.9	0.2861

ON SOME CONSTRUCTIONS IN A CYLINDER AND IN A CONE.

By ERNEST SCHUBERT.

I. If we make transverse sections through the axis and sides of a right cylinder, each section starting from one and the same point, A, in one of its sides, then all the different sections will be ellipses, and the geometrical locus of the foci of those ellipses can be constructed, without any calculation, by means of rule and compass.

Fig. 1.



Let $A\ B$, the diameter of the cylinder, be denoted by unity, and the variable angle which any section makes with $A\ B$, by t. Then (Fig. 1) we have,

$$\sec t = 2\ a,\ (a = \text{semi-major axis,})$$
$$a = \tfrac{1}{2} \sec t,$$
$$b = \tfrac{1}{2},\ (b = \text{semi-axis minor,})$$
$$a^2 - b^2 = e^2 = \tfrac{1}{4}\ (\sec^2 t - 1),$$
$$e = \tfrac{1}{2}\ (\sec^2 t - 1)^{\frac{1}{2}} = \tfrac{1}{2} \operatorname{tang} t\ ;$$
$$\text{and } p = \tfrac{1}{2} \cos t,\ (p \text{ denoting the semi-parameter.})$$

Denoting now the radius-vector of the locus by R, we have for its polar equation

$$R = \tfrac{1}{2}\ (\sec t \pm \operatorname{tang} t).$$

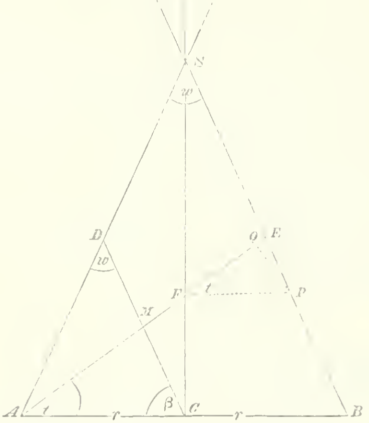
When $t = 0°$, $\sec t = 1$, $\tan t = 0$, and $R = \frac{1}{2}$, which shows that the curve *bisects* $A\ B$. When $t = 270°$, $\sec t = \infty$, $\tan t = \infty$, and $R = 0$, which shows that the curve *originates* at A. The side B of the cylinder is an asymptote to the curve, as is evident from inspection. To construct the curve, it is simply necessary to set off $D\ G$ and $D\ H$ each equal to $C\ D$. From the above equations it is evident that the distance of the point of bisection of the major axis, by the axis of the cylinder, from C, is always equal to the eccentricity of the elliptic section.

II. If in a right cone $A\ S\ B$, of which the vertical angle is ω, sections be made through a point A, at a given distance from the vertex, S; then the different curves made by those sections can be determined and expressed in functions of the variable angle $B\ A\ E = t$.

Assume that

$$A\ S = 1,$$
$$A\ D = C\ D = \tfrac{1}{2},$$
$$A\ C = r = \sin \tfrac{1}{2}\ \omega,$$
$$\text{and } \beta = 90° - \tfrac{1}{2}\ \omega.$$

Fig. 2.



Then (Fig. 2), $C\ D$ being drawn parallel to $B\ S$, the section through it will be a parabola, of which $A\ B$ is a double ordinate, and $C\ D$ the corresponding abscissæ; hence (p_1 denoting the parameter) the equation,

$$p_1 = 2 \sin^2 \tfrac{1}{2}\ \omega.$$

In the triangle $C\ D\ A$, we have

$$C\ M = \frac{r \sin t}{\sin (t + 90 - \frac{\omega}{2})} = \frac{\sin \frac{1}{2}\ \omega \sin t}{\cos (t - \frac{1}{2}\ \omega)},\quad A\ M = \frac{r \sin \beta}{\cos (t - \frac{1}{2}\ \omega)} = \frac{\sin \frac{1}{2}\ \omega \cos \frac{1}{2}\ \omega}{\cos (t - \frac{1}{2}\ \omega)} = a\ (a = \text{semi-major axis}).$$

$$\therefore D\ M = C\ D - C\ M = \tfrac{1}{2} - \frac{\sin \frac{1}{2}\ \omega \sin t}{\cos (t - \frac{1}{2}\ \omega)} = \frac{\cos (t + \frac{1}{2}\ \omega)}{2 \cos (t - \frac{1}{2}\ \omega)}.$$

If $D\ M$ be taken for another abscissæ of the parabola, the corresponding ordinate will be the semi-minor axis, b, in the elliptic section $A\ E$, because the centers of all the ellipses and hyperbolas must necessarily be in the axis $C\ D$ of the parabola, or in its prolongation.

Whence,

$$b^2 = 2 \sin^2 \tfrac{1}{2}\ \omega\ .\ D\ M = \sin^2 \tfrac{1}{2}\ \omega\ \frac{\cos (t + \frac{1}{2}\ \omega)}{\cos (t - \frac{1}{2}\ \omega)}\ ;\quad \therefore b = \sin \tfrac{1}{2}\ \omega \left(\frac{\cos (t + \frac{1}{2}\ \omega)}{\cos (t - \frac{1}{2}\ \omega)}\right)^{\frac{1}{2}}.$$

In the ellipse, the semi-parameter,

$$p_{\frac{1}{2}} = \frac{b^2}{a},$$
$$= \text{tang}\,\tfrac{1}{2}\,\omega\,(\cos\tfrac{1}{2}\,\omega\cos t - \sin\tfrac{1}{2}\,\omega\sin t),$$
$$= \sin\tfrac{1}{2}\,\omega\,(\cos t - \text{tang}\,\tfrac{1}{2}\,\omega\sin t),$$
$$= \sin\tfrac{1}{2}\,\omega\cos t\,(1 - \text{tang}\,\tfrac{1}{2}\,\omega\,\text{tang}\,t).$$

In the diagram, $C\,S = \cos\frac{1}{2}\,\omega$, $F\,C = \sin\frac{1}{2}\,\omega\,\text{tang}\ t$, $F\,S = \cos\frac{1}{2}\,\omega - \sin\frac{1}{2}\,\omega\,\text{tang}\ t = \cos\frac{1}{2}\,\omega\,(1 - \text{tang}\,\frac{1}{2}\,\omega\,\text{tang}\,t)$, and $F\,P = F\,S\,.\,\text{tang}\,\frac{1}{2}\,\omega = \sin\frac{1}{2}\,\omega\,(1 - \text{tang}\,\frac{1}{2}\,\omega\,\text{tang}\,t)$. This result shows that the semi-parameter of any elliptic section is equal to the ordinate passing through the axis of the cone, multiplied by $\cos t$. It likewise furnishes a very neat and simple construction of the semi-parameter, viz.: —

Draw $F\,P$ parallel to $A\,B$, and $P\,Q$ perpendicular to $A\,E$; then $F\,Q$ will be the semi-parameter. For,

$$F\,Q = F\,P\,.\,\cos E\,F\,P = F\,P\cos t.$$

The distance of the point of bisection M from C is, as in the cylinder, equal to the eccentricity of the section. For

$$a^2 - C\,M^2 = \frac{\sin^2\frac{1}{2}\,\omega\cos^2\frac{1}{2}\,\omega}{\cos(t - \frac{1}{2}\,\omega)^2} - \frac{\sin^2\frac{1}{2}\,\omega\sin^2 t}{\cos(t - \frac{1}{2}\,\omega)^2} =$$
$$\sin^2\tfrac{1}{2}\,\omega\,\frac{(\cos^2\frac{1}{2}\,\omega - \sin^2 t)}{\cos(t - \frac{1}{2}\,\omega)^2} = \sin^2\tfrac{1}{2}\,\omega\,\frac{\cos(t + \frac{1}{2}\,\omega)}{\cos(t - \frac{1}{2}\,\omega)},$$

which is identical with the expression for b Hence the eccentricity

$$e_1 = \frac{\sin\frac{1}{2}\,\omega\sin t}{\cos(t - \frac{1}{2}\,\omega)},$$

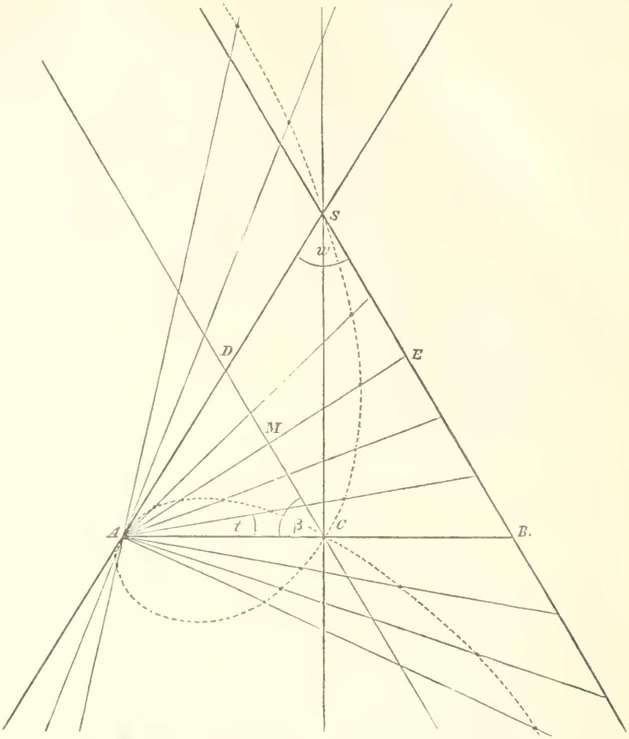


Fig. 3.

and the polar equation of the locus of all the foci of the sections is,

$$R_1 = \frac{\sin\frac{1}{2}\,\omega}{\cos(t - \frac{1}{2}\,\omega)}\,(\cos\tfrac{1}{2}\,\omega \pm \sin t)\ ;\ \text{see fig. 3.}$$

When $t = 0°$, $\cos(t - \frac{1}{2}\,\omega) = \cos\frac{1}{2}\,\omega$, $\sin t = 0$, and $R_1 = \sin\frac{1}{2}\,\omega$, showing that the curve passes through C, the center of the base. When $t = 270° - \frac{1}{2}\,\omega$, $\cos(t - \frac{1}{2}\,\omega) = -\sin\omega$, $\sin t = -\cos\frac{1}{2}\,\omega$, and

$$R_1 = -\frac{\sin\frac{1}{2}\,\omega}{\sin\omega} \times 0 = 0,$$

showing that the curve originates at A, as it evidently ought to do.

THIRTY-SIXTH AND THIRTY-SEVENTH ASTEROIDS.

Mr. Bruhns has sent me the following observations of the planet discovered by Mr. Goldschmidt in Paris. They were made by Dr. Förster of the Berlin Observatory, with the equatorial.

1855.	Berlin M. T.	㊱ — *		㊱'s apparent		No. of Comp	*
		Δα	Δδ	α	δ		
	h. m. s.	m. s.	′ ″	° ′ ″	° ′ ″		
Oct. 12	10 33 3.9	−1 37.340	+8 30.1	343 50 32.0	−6 48 49.0	12	a
13	10 36 53.2	−0 55.373	−2 52.8	343 39 38.1	6 39 46.6	10	b
16	11 23 50.3	+2 15.221	+6 11.7	343 9 50.6	6 12 5.3	10	c
17	9 46 31.4	+3 14.907	−2 56.4	343 1 43.8	−6 3 15.6	9	d

Adopted Mean Places, 1855.0, *of Comparison-Stars.*

	° ′ ″	° ′ ″	Authority.
a	344 14 8.7	−6 57 34.4	Bessel's Zones, 123
b	343 52 45.8	6 37 8.9	" " 122
c	342 35 20.0	6 18 31.9	" " 122
d	342 12 18.1	−6 0 34.0	" " 122

The thirty-seventh asteroid, discovered by Dr. LUTHER, in Bilk, has received the name of *Fides*. The following observations made by Dr. LUTHER, in Bilk, Dr. SCHÖNFELD, in Bonn, and Dr. FÖRSTER, in Berlin, have been communicated by these gentlemen respectively.

1855.	M. T. Bilk.	㊲ α	㊲ δ
	h. m. s.	° ′ ″	° ′ ″
Oct. 5	9	2 25	+0 52
6	8 41 14.4	2 12 21.4	0 49 18.2
6	9 39 18.6	2 11 47.6	+0 49 12.9

1855.	M. T. Bonn.	㊲ α	㊲ δ
	h. m. s.	° ′ ″	° ′ ″
Oct. 9	11 56 15.4	1 32 26.2	+0 37 30.3
10	8 53 28.6	1 21 46.3	0 31 21.6
16	8 9 56.4	0 12 3.5	+0 14 42.5

		㊲ — *					
1855.	M. T. Berlin.	Δα	Δδ	㊲ α	㊲ δ	No. Comp.	*
	h. m. s.	m. s.	′ ″	° ′ ″	° ′ ″		
Oct. 8	12 33 37.0	+0 34.050	+6 10.1	1 44 49.6	+0 41 10.1	12	*a*
12	12 31 28.6	+1 37.130	+0 19.6	0 55 31.3	0 26 50.7	8	*b*
13	11 57 20.2	+0 51.417	—2 55.7	0 44 5.6	0 25 35.4	10	*b*
16	12 28 16.7	+0 23.517	—3 29.8	0 10 17.6	0 14 4.2	12	*c*
17	10 48 35.1	—0 16.290	—6 9.9	0 0 20.5	+0 11 28.9	10	*c*

Mean Places, 1855.0, *of Comparison-Stars.*

	α	δ	Authority.
	° ′ ″	° ′ ″	
a	1 35 34.6	+0 34 40.7	Bessel's Zones, 40; Lal. 131; Santini.
b	0 30 30.0	0 26 11.7	" " 40.
c	0 3 41.8	+0 17 17.2	" " 10; Lal. 47297.

G.

OBSERVATIONS OF ASTEROIDS,

MADE WITH THE NORTHUMBERLAND EQUATORIAL, AT THE CAMBRIDGE (ENG.) OBSERVATORY.

BELLONA.

1855.	M. T. Greenwich.	R. A.	Δ × Par. Cor.	N. P. D.	Δ × Par. Cor.	No. Comp.	*
	h. m. s.	h. m. s.	s.	° ′ ″	″		
June 28	11 38 28.6	18 3 40.72	+0.002	102 31 38.3	—7.73	2	Bessel's Zones, XVIII. 104.
30	11 25 11.6	18 1 58.99	—0.004	102 35 47.3	7.73	8	" " XVII. 1267.
July 4	11 0 46.8	17 58 39.38	—0.013	102 45 8.7	7.74	9	" " " "
12	12 34 41.7	17 52 24.51	+0.186	103 6 45.6	7.60	7	" " XVII. 1050.
21	12 17 1.1	17 46 31.43	+0.217	103 31 19.4	7.55	6	" " XVII. 890.
Aug. 31	8 36 15.4	17 41 19.29	+0.143	106 5 53.5	7.85	8	Hamburg Catalogue, 32549.
Sept. 1	9 13 33.3	17 41 39.52	+0.202	106 9 15.3	—7.70	7	" " "

Assumed Apparent Places of the Stars of Comparison.

	R. A.	N. P. D.		R. A.	N. P. D.
	h. m. s.	° ′ ″		h. m. s.	° ′ ″
June 28	18 5 57.47	102 34 46.0	July 21	17 44 51.79	103 36 21.9
30	18 0 11.93	102 42 46.2	Aug. 31	17 42 22.82	106 6 31.2
July 4	18 0 11.97	102 42 46.0	Sept. 1	17 42 22.80	106 6 31.2
12	17 51 20.28	103 6 45.6			

FIDES.

Discovered by Dr. LUTHER, at Bilk, 1855, Oct. 5.

1855.	M. T. Greenwich.	R. A.	Δ × Par. Cor.	N. P. D.	Δ × Hor. Par.	No. Comp.	*
	h. m. s.	h. m. s.	s.	° ′ ″	″		
Oct. 12	8 10 8.0	0 3 49.26	—0.216	89 32 39.7	—6.72	12	Bessel's O., 9.
19	10 40 9.3	23 58 39.19	+0.051	89 54 9.1	—6.74	10	" Zones, XXIII. 1235.

Assumed Apparent Places of the Stars of Comparison.

	R. A.	N. P. D.
	h. m. s.	° ′ ″
Oct. 12	0 2 4.94	89 33 29.7
19	0 0 17.71	89 42 23.6

NEW PLANET,

Discovered by Mr. Goldschmidt, 1855, Oct. 5.

	M. T. Greenwich.	R. A	Δ × Par. Cor.	N. P. D.	Δ × Par. Cor.	No. Comp.	Authority.
	h. m. s.	h. m. s.	s.	° ′ ″	″		
Oct. 13	8 46 29.6	22 54 40.15	—0.073	96 40 9.5	—7.30	8	Bessel's Zones, XXII. 1205.
18	9 11 14.0	22 51 33.31	+0.011	95 53 43.2	7.25	9	B. A. C. 7993.
20	9 39 13.7	22 50 34.33	+0.068	95 34 19.9	—7.22	6	" "

Assumed Apparent Places of the Stars of Comparison.

	R. A.	N. P. D.
	h. m. s.	° ′ ″
Oct. 13	22 56 59.46	96 57 19.2
18	22 49 49.40	95 34 48.2
20	22 49 49.36	95 34 48.3

In every instance the place of the star is deduced from the Catalogue cited.

LETTER FROM DR. MOESTA TO THE EDITOR.

Santiago de Chile, 12 *August*, 1855.

Having been engaged latterly with the reductions of my meridian observations, my attention was called to certain discrepancies in the azimuth as deduced either from *β Hydri*, or *β Chameleontis* in combination with a clock-star from the *Nautical Almanac*. Moreover, using the value of the azimuth determined by this pair of circumpolar stars, the A. R. of both stars came out always less than that given in the *Nautical Almanac*, which clearly proves the position of one or both to be erroneous. In order to find out the error in question, I collected first all my observations of those days on which *β Hydri* was observed in both culminations, and determined thus the azimuth independently of the given A. R. of the star.* As *β Hydri* is of the 3d magnitude, and the zenith distance more than 68° at its inferior culmination, the observations in both culminations occur only during a few months of the year. In this way I obtained in all some 70 observations from the years 1853, 1854, and 1855; but after having them reduced properly to the beginning of 1854, a strange phenomenon became perceptible, namely, that the A.R. showed a minimum at the end of the month of February, and went on increasing till the month of June, when the A. R. came out very nearly the same as that published in the *Nautical Almanac*.

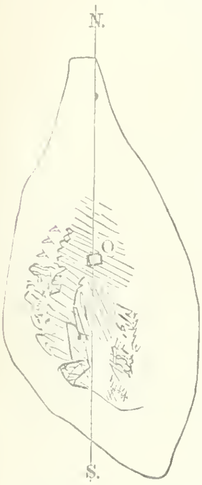
It will be proper here to state, that the instrument is levelled by reversing the level three times, and the collimation obtained by means of the collimating eye-piece, reversing the instrument over a trough of mercury, and that the trunnions have been carefully examined.

For the sake of brevity I quote here only the mean A. R. of *β Hydri*. as deduced from my observations made in the year 1854.

Date.	α	Date.	α	Date.	α
	h. m. s.		h. m. s.		h. m. s.
1854, Jan. 16	0 17 59.52	1854, Mar. 2	0 17 59.67	1854, May 13	0 17 59.70
16	0 17 59.57	11	0 17 59.91	15	0 17 60.29
Feb. 8	0 17 59.43	15	0 17 59.88	15	0 17 59.02
9	0 17 59.43	April 7	0 17 59.76	18	0 17 60.32
11	0 17 59.36	7	0 17 59.74	18	0 17 59.91
11	0 17 59.37	8	0 17 59.69	19	0 17 60.25
13	0 17 59.57	20	0 17 59.88	20	0 17 60.29
13	0 17 59.72	20	0 17 59.91	June 2	0 17 59.95
14	0 17 59.39	30	0 17 59.86	2	0 17 59.91
14	0 17 59.45	May 1	0 17 59.88	3	0 17 60.28
19	0 17 59.50	1	0 17 59.80	3	0 17 60.28
20	0 17 59.64	2	0 17 60.03	4	0 17 60.34
20	0 17 59.75	2	0 17 60.04	5	0 17 60.73
25	0 17 59.40	12	0 17 59.95	5	0 17 59.75
25	0 17 59.37	13	0 17 59.96	6	0 17 59.97
Mar. 1	0 17 59.72				

* The clock-rate for the two transits was obtained by *β Ceti* and *β Corvi*, which differ very nearly $12^{h.}$ in A. R., and about 4° in Dec. As the azimuth was very seldom larger than $0^{s}.4$, no error could be committed greater than $0^{s}.02$ in the time between the two consecutive culminations of the star (*β Hydri*).

It is evident that such a variation in the mean A. R. of *β Hydri* can only be accounted for by assuming the azimuth as variable in the interval between two consecutive culminations of the star. Indeed, having adopted its apparent position from the *Nautical Almanac* as correct, the azimuth resulting from the transit of *β Hydri* and that of a clock-star (also from the *Nautical Almanac*) was always more eastward at night than in the day-time ; and this difference amounts in February on the average to 6 .8 in space. Now if we consider that the upper culmination of *β Hydri* takes place in the middle of February between two and three o'clock in the afternoon, we see at once that at this period of the year the difference in the temperature between the two consecutive culminations of the star is larger than at any other time, amounting sometimes to more than 50° Fahrenheit, as shown by my note-book. No doubt can be entertained that the variation in the azimuth is caused by the heat of the sun, if we take into account the particular situation of the Observatory, and the geological formation of the hill (Cerro de Santa Lucia) on which it is placed. This hill rises abruptly above the plain of Santiago to a height of about 60 metres, the form of its basis resembling somewhat the adjoined figure, which will also show the direction of the meridian. The hill itself consists of porphyry formed in columns of a blackish color, which gives it a very strong resemblance to the Hessian basalts. The Observatory is placed on the northern side of the hill (see point O), and here the columns are placed horizontally with a direction W. 30° N., as indicated by the rays *A A A ;* moreover, the eastern side of the hill is covered with loose earth, whilst on the northern and western part, the columns of the porphyry lie open to the influence of the weather. This brief statement will be sufficient to prove, that the influence is attributable to the sun in his diurnal path. It would appear herefrom that the northern part of the hill *has a daily lateral oscillation or motion from east to west*, like that of the sun. The phenomenon seems almost too striking to be explained in this way, but it loses much of its abstruseness when it is considered that the columns become so hot during the day that the hand cannot be borne upon them.



Adopting the tabulated places of *β Hydri* as correct, I have determined the azimuth every night by the combination of *β Hydri* with several clock-stars from the *Nautical Almanac*, and in this way the A. R. of *β Chameleontis* was obtained. As the position of *β Chameleontis* with regard to that of *β Hydri* is well adapted for the determination of the azimuth-error, the exact position of the former star is of importance for the observer in this hemisphere, and I therefore take the liberty of sending you herewith a list of the differences in A. R. of *β Chameleontis* of all those days for which I have now finished my reductions.

Date.	$\Delta\alpha = O - C.$	Date.	$\Delta\alpha = O - C.$	Date.	$\Delta\alpha = O - C.$	Date	$\Delta\alpha = O - C$
	s.		s.		s.		s.
1854, Feb. 14	—0.66	1854, May 2	—0.37	1854, Oct. 6	—0.21	1854, Nov. 20	—0.20
17	0.29	11	0.64	7	0.03	23	0.74
19	0.75	13	0.62	9	0.12	1855, April 2	0.35
20	0.43	15	0.24	15	0.32	16	0.30
23	0.33	18	0.80	16	0.75	20	0.39
25	0.60	20	0.34	18	0.81	21	0.77
27	0.01	June 2	0.43	23	0.27	25	0.53
Mar. 18	0.23	3	0.56	25	0.73	26	0.27
20	0.41	6	0.68	26	0.66	27	0.44
22	0.50	Sept. 14	0.82	27	0.66	May 5	0.58
24	0.56	15	0.49	30	0.71	8	0.47
26	0.43	16	1.04	Nov. 2	0.59	9	0.77
April 7	0.15	21	0.39	4	0.60	10	0.50
8	0.56	26	0.61	9	0.59	22	0.23
20	0.55	27	0.70	13	—0.07	23	—0.22
May 1	—0.63	Oct. 5	—0.82				

In the year 1854 the transits were observed over six, and in some cases over seven wires ; in the year 1855, over eight wires.

The number of observations for $\Delta\alpha$ is 62, and, giving them equal weights, the probable value of $\Delta\alpha$ is

$$-0^{s}.49,$$

or the mean A. R. of *β Chameleontis* for 1854.0 is

$$12^{h.}\ 9^{m.}\ 52^{s.}.25,$$

with the probable error of

$$\pm 0^{s}.019.$$

I also avail myself of this opportunity to transmit to you enclosed some small corrections of my observations of *λ Tucanæ*, published in No. 82 of the *Astronomical Journal*. On reducing these observations the azimuth-correction was obtained by *β Hydri* and *β Chameleontis*, but rejecting for this purpose the latter star on account of its erroneous position, the A. R. are the following : —

1854.0	h. m. s.	1854.0	h. m. s.
Sept. 16	$\alpha = 0\ 46\ 50.033$	Oct. 15	$\alpha = 0\ 46\ 50.316$
27	50.309	16	50.504
Oct. 6	50.293	18	50.587
7	50.509	23	50.350
9	50.237	Nov. 4	49.993
14	$\alpha = 0\ 46\ 50.321$	9	$\alpha = 0\ 46\ 50.472$
			$\alpha = 0\ 46\ 50.327$

The comparison of this result with Lacaille's Catalogue gives

Proper Motion in $\alpha = -0^s.050$,

and comparing it with 114 of Brisbane's Catalogue, we obtain

Proper Motion in $\alpha = +0^s.141$.

C. W. MOESTA.

LETTER FROM LIEUTENANT GILLISS TO THE EDITOR.

Washington, 12 *November*, 1855.

The preceding letter for the *Journal* came only by the last mail from Chile.

The warping of the hill of Santa Lucia under the influence of the sun, principally treated of by Dr. Moesta, became evident in the early discussion of our instrumental errors, and consequently the subject was at once minutely investigated. You will remember that our rule was to determine the errors both before and after the zone series of each night, not because any such disturbing influence as solar heat was suspected, but to be assured that no earthquake, otherwise insensible, had been agitating the bases of the circle piers. As these observations never occupied less than three and a half hours, unless change of weather interrupted them, there was usually from four and a half to six hours between the first and last azimuth stars, during which the absolute decrease of temperature varied with the season of the year, being a minimum in the winter months, June to August inclusive. For each degree the observations show uniformly a mean variation of the azimuth from

	s.
June to August inclusive,	—0.020
September and October,	.047
November to March,	.078
April and May,	—0.062

From the preponderance of cloudy nights during winter, the result for that season is based on a smaller number of observations than the others, but the general accordance of individual determinations indicates the law of change not less satisfactorily. Dr. Moesta, you will perceive, has obtained almost precisely the same.

There is yet another instrumental disturbance to which the circle was subject whilst we were in Chile, and which was still going on when I last asked Dr. Moesta respecting it, namely, constant elevation of its eastern pivot! In the two and a half years that the circle was in use by us, this pivot was lowered 1′ 31″, the uplifting being uniformly about $5\frac{1}{2}''$ per month throughout the spring, summer, and autumn months, and the axis fluctuating about a horizontal line in winter, with an upward tendency of the western pivot. There was no return to the normal horizontal line, as there was to the plane of the meridian, but the hill seemed progressively tilting from east to west. You will find further notice of it on pages 126, 127, Vol. I., *U. S. Naval Astronomical Expedition*, and also in the *Introduction* to Vol. IV. of the series.

Apart from these objections, there are others which render Santa Lucia one of the worst possible sites for an observatory, and which would have induced me to remove it could we have spared the time. Astronomers will, therefore, be glad to learn, that the government of Chile has determined to erect a substantial and commodious building in the suburbs of the capital.

The Santiago papers mention that on the 29th of August, Dr. Moesta had found Encke's Comet near the star *f Lupi*. It appeared only as an extremely faint nebula. Was it seen at any observatory of the northern hemisphere?

J. M. GILLISS.

CORRIGENDA.

Vol. IV. page 77, column 2, last line, *for* comparison, *read* companion.
" " 78, " 2, " 16, " fixed, " first.

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Ephemeris of Egeria for 1855–56, by Professor J. S. Hubbard.
On some Constructions in a Cylinder and in a Cone, by Ernest Schubert.
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Observations of Asteroids, made with the Northumberland Equatorial, at the Cambridge (Eng.) Observatory.
Letter from Dr. Moesta to the Editor.
Letter from Lieutenant Gilliss to the Editor.
Corrigenda.

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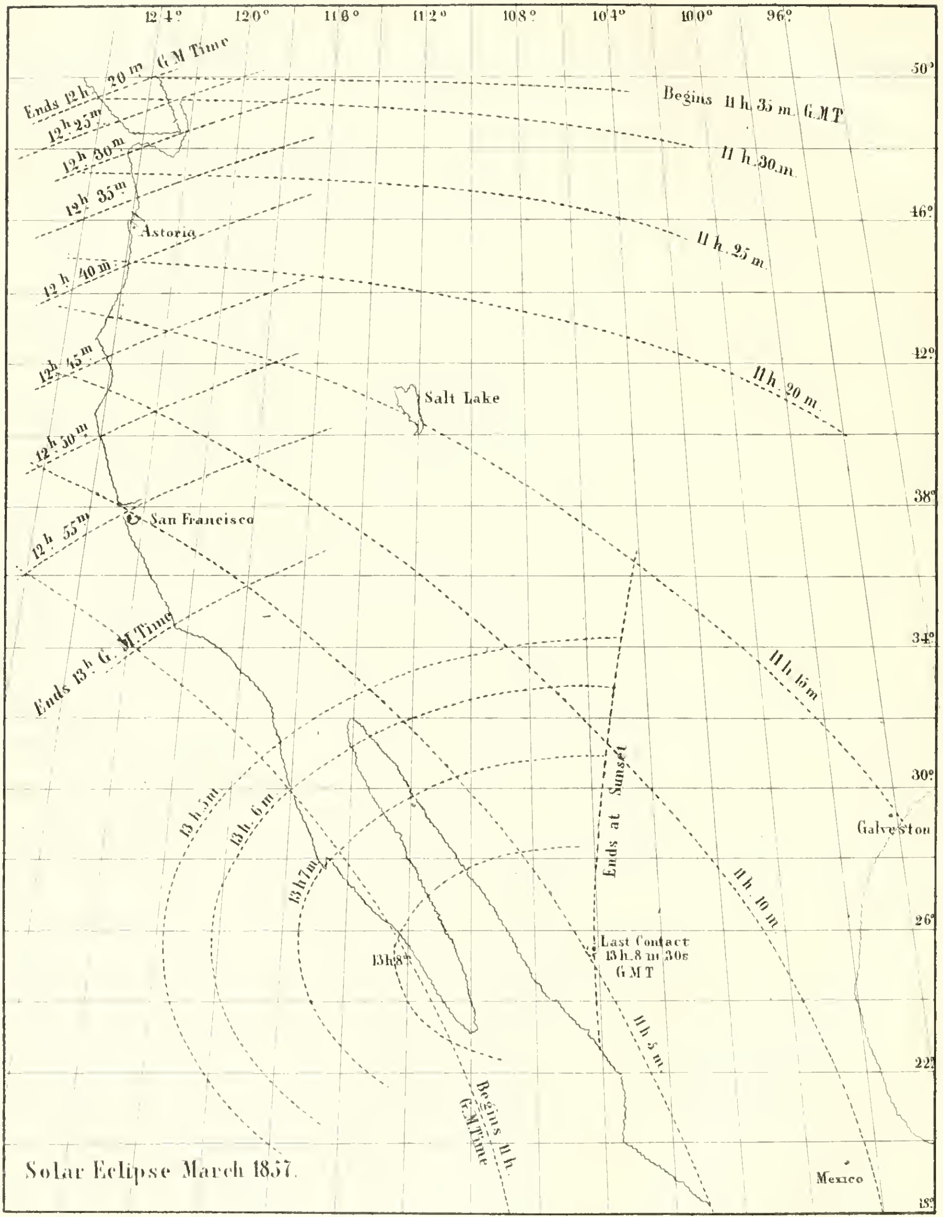

Solar Eclipse March 1857.

Moore & Crosby lith Boston

ASTRONOMICAL JOURNAL VOL. IV. PL. 3.

THE

ASTRONOMICAL JOURNAL.

No. 90.

VOL. IV. CAMBRIDGE, 1856, JANUARY 9. NO. 18.

LETTER FROM PROFESSOR AIRY, ASTRONOMER ROYAL, TO THE EDITOR.

Royal Observatory, Greenwich.

You are aware, I believe, that I was lately occupied with the endeavor to make myself acquainted with Professor Peirce's theory on the rejection of discordant observations, given first by Professor Peirce in No. 45 of the *Astronomical Journal*, and afterwards carried out more completely by yourself in No. 83 of the same work; and you are also aware that I found sundry difficulties on points of detail in the investigation. In the attempt to master these, I have been compelled carefully to consider the subject from its first principles. And I have, not without surprise to myself, been led to think, that the whole theory is defective in its foundation, and illusory in its results; that no rule for the exclusion of observations can be obtained by any process founded purely upon a consideration of the discordance of those observations; and that the only rule (imperfect as it may be) by which such exclusion can be justified, must be based upon considerations of a totally different kind.

In the explanation of my views, I will consider two cases which appear, at first sight, to differ; namely, the first case, where the "probable error" is not known from groups of observations anterior to those under consideration; and the second case, where there have been such antecedent observations, from which a "probable error" may have been inferred.

In the first case, then, (which is fully included in Professor Peirce's theory,) I assert that no consideration of the discordances *per se* can justify us in rejecting any observation, so long as we are satisfied that the same causes of error have been operating, though in different degrees, upon the entire series of observations. The whole conception of "probability" is founded on the assumption that errors of very different (but not unlimited) magnitudes may exist in different instances under the influence of the same causes of error throughout, without in any degree implying the necessary intervention of other causes of error for the creation of the errors of the largest magnitude. (The limitation shall be the subject of consideration shortly.) The mathematical formula for probability implies that error of any magnitude is "possible" under the operation of the same causes, although the "probability" (i. e. the "frequency" in a great number of instances) is very much less for large errors than for small ones. The conception of a process for inferring the magnitude of a "probable error," (i. e. such a magnitude that in a great number of instances it is an even chance whether the error is greater or less than that magnitude,) implies that the actual errors may in some instances greatly exceed that probable magnitude; and no subsequent consideration of that probable error (or, which amounts to the same thing, no subsequent consideration of the discordances from which such probable error was or could be deduced) will justify us in an *à posteriori* rejection of any of the observations from which it was deduced. In seeking for truth or accuracy in a matter of chance, we are bound to take all the evidence that we can find; every individual observation contributes its evidence; and if we have no *à priori* reason for preferring one observation to another while we are yet in the dark as to the result, and no cogent reason for supposing that unusual causes of error must have intervened in special observations, we are bound to admit all on the same terms, as giving equally valid evidence.

It appears to me that, in the whole process to which I am alluding, there is a fault of reasoning of a vital character; namely, the assumption that we can apply the reasoning of antecedent probability to the discussion of observations which are recorded as having been actually made. In ordinary life, instances perpetually occur (some of a permanent, some of a transient character) which, considered beforehand, are in the highest degree improbable, but which, as matters of history, are absolutely certain.

The second case, it appears to me, does not differ essentially from the first. In some instances, the group of observations under immediate treatment may be contemplated as part of an extended group which includes both the past and the present observations, and the reasoning above applies to the whole. In other instances the observations (applying, perhaps, to different objects) cannot be so combined; but the knowledge of the "probable" error derived from former observations still leaves open the "possibility" of large "actual" errors in the new series, just as if the observations admitted of being combined.

Perhaps the possibility of a wide range of errors, and also the limitation to it, may be better understood upon considering that an error of observation is in general the result of the combination of several totally independent errors. Suppose, for instance, in examining the observed zenith-distances of *Polaris*, I find one differing four seconds from the mean. This is a very large discordance, and one which would be at once marked as inadmissible by Professor Peirce's theory. But I consider that several causes may have co-operated to form this error. The bad definition of the star, or the failure in the nervous system of the observer's eye, may have done something. The failure of the nervous or muscular system of his fingers, in turning the micrometer screw, may have contributed a part. The irregular blasts of wind upon the spokes of the circle may have distorted it. The computation of refraction (including the effects of chance errors in barometer and thermometer readings) may have been erroneous. Each of these causes may have produced an error of 1″, and, supposing all to have had the signs $+ + + +$, their combination will account for the error of 4″. This large discordance, then, may be explained by the action of causes which act on all observations; and the result must be retained.

But is it not injurious to retain such a result? I cannot say; but it is quite as probable that its retention will be beneficial. In a group of observations, it is probable that there will be one with a — error depending on the observer's eye, another with a — error depending on the observer's fingers, and so on; and all these will be corrected by introducing, to form the general mean, this apparently discordant observation.*

But suppose that, instead of an error of four seconds, I found an error of forty seconds in a zenith-distance of Polaris. I cannot conceive that any one of such errors as I have described can amount to ten seconds. I am driven to the supposition, that there was something extraordinary, as a slip of the clamp. I do not recognize this explanation of failure as included among the causes of errors to which all observations are subject, and I therefore reject the observation.

And here, as it seems to me, we are come to the real consideration upon which depends the partial failure of the mathematical theory of probabilities, which partial failure stimulates the mind to seek for remedy in a more refined modification of the theory, such as Professor Peirce has proposed. The mathematical expression, that the frequency of errors included in magnitude between Δ and $\Delta + \delta\Delta$ is proportional to $\delta\Delta \times \varepsilon^{-\frac{\Delta^2}{a^2}}$, is adopted because, as far as errors generally range, it will very well represent their actual law. But, upon carrying it to extremes, the mathematical formula asserts that, under the ordinary action of the causes of chance errors, an error of *any* magnitude, though improbable, is possible. Common sense tells us, that a very large error is not only improbable, but is really impossible. In applying the theory of probabilities, then, to those cases in which the very large errors are the important points under consideration, we are veritably using the failing part of the theory; and our conclusions will naturally be worthless.

It appears to me, therefore, that we must in this case abandon the mathematical theory altogether, and we must rely upon the application of our mental reasoning to the independent examination of the special cases which may come before us, by a process bearing some analogy to that which I have instanced above. However irregular or uncertain — and therefore however unsatisfactory — this operation may be, I do not see that any other can be properly employed.

Remarking that, in problems notoriously so slippery as those which relate to questions of chance, there can be no impropriety in two persons holding for a time two opinions, I would ask leave to invite your attention, and that of Professor Peirce, to the considerations which I have endeavored to explain.

In conclusion, I will give a *résumé* of the principal points on which I have insisted above.

1. The mathematical theory of probabilities fails in all questions applying to errors of extreme magnitude.
2. No consideration of the magnitudes of residual errors *per se* will justify us in rejecting a result.
3. We are justified in rejecting a result only when, from the best estimate that we can form of the extent of action of the various causes which can produce error, we find that the combination of those causes of error cannot possibly produce the discordance in question; —
4. And when we perceive that other causes may have intervened, whose nature is such that they cannot be recognized as occurring in the ordinary series of observations.

G. B. AIRY.

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* This case is not purely imaginary. The following is a remarkable instance. In the last century, when the figure of the earth was not well known, observations of reciprocal azimuths were made at Beachy Head and Dunnose for determining the scale of longitudes for England. The result was considerably in error. The books of observations subsequently came into the custody of General Colby, and he found that only the "picked" and most accordant observations had been used; and when the whole were employed (including the most discordant) the result was perfectly good. I received this information from General Colby himself.

LETTER FROM REV. THOMAS HILL TO THE EDITOR.*

Waltham, 1855, *Oct.* 15.

I send herewith a chart of the solar eclipse of March, 1857, as it passes on and off the Pacific coast. The whole time occupied in preparing the chart, from the time the tables of the moon were first opened until the drawing was finished, was less than six hours. The accuracy is probably about the same as that of the calculations made by the same instrument for the eclipse of May, 1854 (*Astronomical Journal*, Vol. III. p. 153); few of the errors exceeding one minute of time.

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* I much regret that the distribution of these charts has been so long delayed by some mistake consequent upon my absence in Europe.

G.

T. HILL.

OBSERVATIONS OF PLANETS AND COMET, MADE AT THE HAMBURG OBSERVATORY.

By PROFESSOR CHARLES RÜMKER.

THE observations were mostly made by Mr. GEORGE RÜMKER.

EUPHROSYNE.

1855.	Hamburg M. T.	Apparent A. R.	Log. Fact. of Parall.	Apparent Dec.	Log. Fact. of Parall.	No. of Comp.	Apparent Places of Comparison-Stars. α	δ
	h. m. s.	° ′ ″		° ′ ″			h. m. s.	° ′ ″
Sept. 6	15 18 39.5	123 50 4.7	9.8936 *n*	+40 21 0.0		3	8 17 9.185	40 21 41.1
18	14 28 15.3	130 45 45.6	9.8902 *n*	40 12 59.3	9.7544	12	8 40 33.283	40 7 23.2
21	14 21 28.6	132 27 7.9	9.7568 *n*	40 10 9.7	9.8896	16	8 52 20.497	40 16 46.5
22	14 15 17.9	133 0 40.1	9.8778 *n*	+40 8 40.3	9.7717	24	8 52 20.522	40 16 46.3

HEBE.

1855.	Hamburg M. T.	Apparent A. R.	Log. Fact. of Parall.	Apparent Dec.	Log. Fact. of Parall.	No. of Comp.	Comparison-Stars.
	h. m. s.	° ′ ″		° ′ ″			
Aug. 8	10 35 38.9	334 3 1.2	9.5796 *n*	—13 29 56.6	9.9492	2	*g*
9	10 11 32.4	333 54 39.1	9.6238 *n*	13 44 23.7	9.9459	9	*e, f*
10	10 45 46.1	333 45 53.7	9.5306 *n*	13 59 41.6	9.9539	5	*d, e*
	12 59 22.1	333 41 57.0		14 1 8.4	9.9653		Meridian.
11	9 47 42.1	333 37 9.3	9.6529 *n*	14 14 8.2	9.9436	7	*d*
12	9 57 25.7	333 27 47.3	9.6260 *n*	14 29 23.5	9.9473	7	*d*
	12 50 17.7	333 26 45.0		14 31 24.7	9.9668		Meridian.
13	12 45 43.6	333 17 14.1		14 46 42.5	9.9682		"
18	10 3 1.8	332 27 35.0	9.5530 *n*	16 2 35.8	9.9572	4	*c*
	12 22 42.6	332 26 39.4		16 4 9.5	9.9714		Meridian.
21	9 55 54.8	331 55 23.9	9.5315 *n*	16 49 17.4	9.9602	3	*a*
22	9 32 56.6	331 44 42.4	9.5924 *n*	17 4 35.2	9.9554	5	*b*
	12 4 6.9	331 43 32.8		17 6 17.5	9.9743		Meridian.
26	11 45 28.3	330 59 41.7		18 7 22.5	9.9769		"
27	11 40 48.7	330 48 42.9		18 22 27.2	9.9775		"
28	11 36 9.2	330 37 48.2		18 37 17.7	9.9782		"
31	11 22 13.6	330 5 43.6		19 21 1.9	9.9799		"
Sept. 2	11 12 58.8	329 44 56.6		19 49 10.9	9.9810		"
5	10 59 12.1	329 15 7.3		20 29 49.4	9.9826		"
6	10 54 38.4	329 5 38.5		—20 42 49.6	9.9830		"

Mean Places of Comparison-Stars for 1855.0 *derived from Observations with Meridian-Circle.*

	Mean A. R.	Mean Dec.
	h. m. s.	° ′ ″
a	22 6 46.933	—16 31 19.6
b	22 8 58.263	17 6 11.4
c	22 12 18.828	16 0 35.6
d	22 16 40.779	14 15 48.6
e	22 16 48.144	13 55 1.8
f	22 16 58.998	13 41 24.7
g	22 18 24.410	—13 32 7.5

FIDES.

1855.	Hamburg M. T.	㊱ α	㊱ δ	No. of Comp.	Apparent Places of Comparison-Stars. α	δ
	h. m. s.	° ′ ″	° ′ ″		h. m. s.	° ′ ″
Oct. 7	7 50 27.0	2 0 3.3	+0 45 49.0	17	0 6 25.21	+0 34 59.3
8	7 46 54.1	1 47 14.9	0 41 55.1	15	0 6 25.21 0 7 14.00	0 34 59.3 0 29 45.9
13	10 10 13.0	0 44 57.0	0 23 59.4	19	0 2 4.94	0 26 30.3
15	9 2 37.6	0 22 45.5	0 17 37.3	11	0 0 17.67	0 17 38.0
16	8 23 22.2	0 12 9.8	0 14 39.3	11	0 0 17.67	+0 17 38.0
19	10 19 40.0	359 40 20.7	+0 5 50.8	15	0 1 29.64 0 0 17.66	—0 6 35.3 +0 17 38.0
Nov. 2	6 56 24.0	358 0 15.0	—0 15 39.6	4	23 49 3.87 23 49 58.68	—0 19 12.6 0 6 56.6
8	7 19 9.0	357 41 57.0	0 15 14.7	12	23 49 3.84	0 19 12.9
10	7 16 36.0	357 39 19.8	0 13 46.2	10	23 49 3.84	0 19 12.9
13	6 43 1.1	357 38 58.8	—0 10 19.3	15	23 49 58.60	—0 6 57.0

ATALANTA.

1855.	Hamburg M. T.	㊲ α	㊲ δ	No. of Comp.	Apparent Places of Comparison-Stars. α	δ
	h. m. s.	° ′ ″	° ′ ″		h. m. s.	° ′ ″
Oct. 12	10 13 53.0	343 50 38.7	—6 48 42.3	5	22 56 59.44	—6 57 19.3
13	8 4 35.9	343 40 42.6	6 40 34.5	18	22 55 33.91	6 36 53.8
15	9 50 17.5	343 19 31.7	6 21 35.0	2	22 51 7.93	6 26 36.9
16	7 21 24.0	343 11 27.9	6 13 20.1	7	22 50 39.99	6 27 21.7
	9 6 40.0	343 10 35.6	6 12 34.3	2	22 51 7.37	6 26 36.2
Nov. 8	8 43 24.0	342 12 22.0	—2 16 24.8	12	22 50 58.12	—2 10 49.7

Nov. 8th. A somewhat smaller star was observed near the planet in A. R. 342° 11′ 14″.2, Dec. —2° 14′ 8″.4, which I mention because the small motion of the planet makes it rather uncertain which of the two stars was the planet.

Oct. 13th. About $10^{h.}$ $30^{m.}$ the planet nearly covered a star of the same magnitude.

Oct. 16th. At $9^{h.}$ the planet passed 5″ southerly of a star of the same magnitude.

PSYCHE.

1855.	Hamburg M. T.	A. R.	Dec.	No. of Comp.	Apparent Place of Comparison-Star, 55 *Tauri.* α	δ
	h. m. s.	° ′ ″	° ′ ″		h. m. s.	° ′ ″
Nov. 20	8 14 21.9	62 36 28.9	+16 15 26.2	16	4 11 40.813	+16 20 28.04

COMET 1855, III.

1855.	Hamburg M. T.	☄'s Apparent A. R.	☄'s Dec.	No. of Comp.	Apparent Places of Comparison-Stars. α	δ
	h. m. s.	° ′ ″	° ′ ″		h. m. s.	° ′ ″
Nov. 20	16 36 27.2	142 14 59.4	+2 16 57.2	10	9 29 58.82 9 30 14.61 9 30 51.51	+2 31 34.9 2 20 35.9 2 29 16.2
21	17 45 26.3	140 50 54.6	+2 19 58.2	4	9 25 13.92 9 24 4.51	2 30 10.5 +2 6 5.2

The last observation was made under very unfavorable circumstances.

COMET-CIRCULAR.

Mr. C. Bruhns writes from Berlin, 1855, Nov. 12, as follows: —

"Permit me to communicate to you the discovery of a new comet. I found it about $15\frac{1}{4}^{h.}$, and have observed it as follows: —

	Mean Berlin Time.	☄'s apparent α	δ
November 12	$17^{h.}$ $21^{m.}$ $53^{s.}$.3	149° 1′ 25″.7	+2° 7′ 15″.3

"The comet appears like a feeble nebula, and its daily motion is

in R.A. about —20′ of arc.
in Dec. almost 0′."

Cambridge, 1855, *Dec.* 11.

ELEMENTS AND EPHEMERIS OF FIDES, AND THE THIRD COMET OF 1855.

By Mr. GEORGE RÜMKER.

ELEMENTS OF FIDES.

These elements are computed from the following observations: Bilk, Oct. 6; Berlin, Oct. 23; Hamburg, Nov. 2 and 13.

M	322° 17′ 40″.3	Nov. 0.0, 1855, Greenwich M. T.
π	63 26 6.9	Mean Equinox,
☊	8 8 56.2	Jan. 0.0, 1856.
i	3 11 43.6	
φ	8 22 25.8	
Log a	0.415680	
" μ	2.926487	

Ephemeris for 12^{h.} Berlin Mean Time.

1855.	Apparent R. A.	Apparent Dec.	Log. △	1855.	Apparent R. A.	Apparent Dec.	Log. △
	h. m. s.	° ′			h. m. s.	° ′	
Nov. 24	23 52 49	+0 17.0	0.2272	Dec. 13	0 4 4	+1 46.8	
25	53 11	0 20.4		14	4 53	1 52.9	0.2796
26	53 35	0 24.0		15	5 44	1 59.2	
27	54 0	0 27.7		16	6 36	2 5.6	
28	54 27	0 31.6	0.2377	17	7 30	2 12.1	
29	54 55	0 35.6		18	8 24	2 18.8	0.2899
30	55 25	0 39.7		19	9 20	2 25.6	
Dec. 1	55 56	0 44.0		20	10 16	2 32.4	
2	56 28	0 48.4	0.2482	21	11 14	2 39.3	
3	57 3	0 53.0		22	12 13	2 46.2	0.2999
4	57 39	0 57.8		23	13 13	2 53.3	
5	58 17	1 2.7		24	14 14	3 0.4	
6	58 56	1 7.8	0.2588	25	15 16	3 7.8	
7	23 59 37	1 12.9		26	16 19	3 15.2	0.3098
8	0 0 17	1 18.2		27	17 23	3 22.8	
9	0 59	1 23.6		28	18 28	3 30.4	
10	1 43	1 29.2	0.2693	29	19 34	3 38.2	
11	2 19	1 34.9		30	0 20 42	+3 36.0	0.3195
12	0 3 16	+1 40.8					

ELEMENTS OF THE COMET 1855, III.

T	Nov. 25.66041, 1855, Greenwich M. T.	
π	85° 21′ 41″	Apparent Equinox,
☊	52 2 47	November 15.
i	10 16 29	
Log q	0.088070	
	Retrograde.	

These elements are computed from the following observations: Berlin, Nov. 12; Bilk, Nov. 15; and Hamburg, Nov. 20.

Ephemeris for 12^{h.} Berlin Mean Time.

1855.	Apparent R. A.	Apparent Dec.	Log △	1855.	Apparent R. A.	Apparent Dec.	Log △
	h. m. s.	° ″			h. m. s.	° ′	
Nov. 24	9 4 18	+2 30.4	9.7218	Dec. 1	7 25 31	+3 25.0	9.5043
25	8 55 37	2 35.8		2	7 0 55	3 35.2	9.4751
26	8 45 50	2 42.0	9.6625	3	6 32 48	3 44.4	9.4498
27	8 34 12	2 48.9		4	6 1 57	3 50.9	9.4311
28	8 20 46	2 56.5	9.6007	5	5 28 35	3 54.7	9.4200
29	8 4 48	3 5.2		6	4 54 13	3 53.1	9.4187
30	7 46 48	+3 15.0	9.5359	7	4 20 35	+3 47.2	9.4270

1855.	Apparent R. A.	Apparent Dec.	Log △	1855.	Apparent R. A.	Apparent Dec.	Log △
	h. m. s.	° ′			h. m. s.	° ′	
Dec. 8	3 48 49	+3 38.1	9.4442	Dec. 20	0 50 37	+2 0.3	9.7942
9	3 19 56	3 26.2	9.4679	21	45 15	1 57.7	
10	2 54 27	3 14.3	9.4964	22	40 30	1 55.7	9.8412
11	2 32 16	3 1.1	9.5275	23	36 15	1 54.1	
12	2 13 12	2 48.5	9.5599	24	32 28	1 52.9	9.8840
13	1 56 50	2 39.0		25	29 3	1 52.1	
14	1 42 50	2 31.5	9.6248	26	25 59	1 51.6	9.9231
15	1 30 48	2 24.3		27	23 13	1 51.4	
16	1 20 27	2 17.6	9.6862	28	20 42	1 51.5	9.9591
17	1 11 15	2 12.0		29	18 25	1 51.8	
18	1 3 33	2 7.4	9.7427	30	0 16 20	+1 52.4	9.9924
19	0 56 40	+2 3.5					

CORRECTIONS OF THE LOGARITHMS OF *A*, *B*, *C*, *D*, IN THE TABULÆ REGIOMONTANÆ.

By PROFESSOR J. S. HUBBARD,

OF THE WASHINGTON OBSERVATORY.

The logarithms of *A*, *B*, *C*, *D*, given in Table VIII. of the *Tabulæ Regiomontanæ*, render the computation of the reductions to mean or apparent places of stars during the past century exceedingly simple and convenient. But, inasmuch as the values of the constants upon which they are based differ sensibly from those at present received, it becomes sometimes desirable, for the sake of greater precision, or uniformity with other calculations, to determine the corresponding corrections either of these logarithms, or of the computed reductions. Special tables or formulas for the latter have been prepared by different astronomers (¹); perhaps the following tables for the former will also be of service in some cases. By their help we obtain the values required by the formulas of PETERS, (²) as adopted in the American and British *Nautical Almanacs*; the notation being that of the *Tabulæ Regiomontanæ*.

In cases where the values of *A* and *B* are so small as to give too large factors for the corrections of the logarithms, it will be more accurate to obtain the corresponding corrections of the natural numbers, by dividing the quantities given above by the modulus of common logarithms ($\log M = 9.6378$).

The values of ☊ adopted by BESSEL are obtainable from the expression (³)

$$☊ = 33^\circ.26 - 19^\circ.3415 \,.\, t,$$

in which *t* denotes the number of tropical years counted from 1800.

Hence, for	1750	☊ = 280°.33	1810	☊ = 199°.84
	1760	86.92	1820	6.43
	1770	253.50	1830	173.01
	1780	60.09	1840	339.60
	1790	226.67	1850	146.18
	1800	33.26		

Δ ☊ for each 10 days = — 0°.52945.

TABLE I.

Date.	$A\Delta_\odot \log A$.	$B\Delta_\odot \log B$.	Date.	$A\Delta_\odot \log A$.	$B\Delta_\odot \log B$.
Jan. 0	—.0002	—.0118	July 9	—.0004	—.0105
10	4	95	19	5	77
20	5	61	29	6	41
30	6	— 20	Aug. 8	6	— 1
Feb. 9	6	+ 24	18	5	+ 42
19	5	65	28	5	78
Mar. 1	4	98	Sept. 7	3	108
11	— 2	119	17	— 1	122
21	0	126	27	+ 1	125
31	+ 2	117	Oct. 7	3	112
April 10	4	95	17	4	87
20	5	63	27	5	51
30	6	+ 23	Nov. 6	6	+ 9
May 10	6	— 20	16	6	— 35
20	5	59	26	5	75
30	4	92	Dec. 6	3	105
June 9	+ 2	115	16	+ 1	122
19	0	126	26	— 1	125
29	—.0002	—.0122	36	—.0003	—.0111

(¹) STRUVE, *Positiones Mediæ Stellarum*; PETERS, *Recherches sur la Parallaxe des Étoiles*.

(²) *Numerus Constans Nutationis*, p. 199.

(³) *Tab. Reg.*, p. xxxi.

TABLE II.

☊	$A\,\Delta_{☊}\log A$.	$B\,\Delta_{☊}\log B$.	☊	☊	$A\,\Delta_{☊}\log A$.	$B\,\Delta_{☊}\log B$.	☊
0°	.0000	—.1061—	360°	90°	—.0039+	—.0008—	270°
5	— 4+	.1057	355	95	39	+ 85+	265
10	7	.1045	350	100	38	177	260
15	10	.1026	345	105	37	268	255
20	13	999	340	110	36	358	250
25	16	964	335	115	35	446	245
30	19	922	330	120	34	530	240
35	22	873	325	125	32	611	235
40	25	817	320	130	30	687	230
45	27	755	315	135	28	757	225
50	29	688	310	140	26	821	220
55	31	616	305	145	23	879	215
60	33	539	300	150	20	930	210
65	35	457	295	155	17	975	205
70	36	371	290	160	13	.1012	200
75	37	283	285	165	10	.1041	195
80	38	193	280	170	7	.1061	190
85	39	101	275	175	— 4+	.1073	185
90	—.0039+	—.0008—	270	180	.0000	+.1078+	180

$$\varDelta \log C = \varDelta \log D = +.0041.$$

For 1826, April 10, Table VIII. of *Tab. Reg.* gives

$$\log A = 9.7491,\quad \log B = 0.5161,\quad \log C = n1.2415,\quad \log D = n0.8447.$$

For the same date, ☊ = 245°.09, and from the above tables we get

	$A\,.\,\varDelta\log A.$	$B\,.\,\varDelta\log B.$
Table I., April 10,	+ 4	+ 95
Table II., 245°.1	+ 35	+ 444
	+ 39	+ 539
	$\varDelta\log A = +$ 69	$\varDelta\log B = +$ 164

And the corrected values are:

$$\log A = 9.7560,\quad \log B = 0.5325,\quad \log C = n1.2456,\quad \log D = n0.8488.$$

OBSERVATIONS OF FIDES, ATALANTA, AND PROSERPINA,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

BY JAMES FERGUSON.

[Communicated by Lieutenant MAURY. — Corrected for refraction.]

FIDES.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㊱ — * Δα	㊱ — * Δδ	㊱'s apparent α	㊱'s apparent δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Nov. 22	8 26 54.55	7	Weisse XXIII. 1075	—0 24.84	— 6 14.23	23 52 12.80	+0 10 58.67
		7	" 1090	—0 58.90	— 4 50.35	23 52 12.90	+0 10 57.97
23	8 28 36.54	7	" 1075	—0 5.37	— 3 4.98	23 52 32.26	+0 14 7.87
		7	" 1090	—0 39.44	— 1 39.72	23 52 32.34	+0 14 8.54
24	7 44 54.59	5	" 1075	+0 14.77	+ 0 8.64	23 52 52.40	+0 17 21.44
		5	" 1090	—0 19.23	+ 1 32.71	23 52 52.56	+0 17 20.93
26	7 11 6.70	6	" 1075	+1 1.00	+ 7 8.55	23 53 38.61	+0 24 21.24
		6	" 1090	+0 26.94	+ 8 32.21	23 53 38.70	+0 24 20.35
27	7 59 23.22	5	" 1075	+1 27.04	+11 0.61	23 54 4.64	+0 28 12.79
		5	" 1090	+0 53.06	+12 24.78	23 54 4.81	+0 28 12.84

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XXIII. 1075	9	23 52 50.30	+0 18 35.59	α, mean of Weisse's Cat.
" 1090	9	23 53 24.45	+0 17 10.85	δ, Mural Circle, Professor Yarnall.

ATALANTA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㊲ — *		㊲'s apparent	
				Δα	Δδ	Δα	Δδ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Nov. 23	7 47 33.5	7	Weisse XXII. 1220	−1 28.46	+ 7 59.10	22 56 26.61	+0 39 51.10
24	7 6 56.2	7	" 1228	−0 55.65	− 7 35.64	22 57 9.63	+0 51 45.87
26	6 41 34.3	6	" 1228	+0 37.65	+16 34.94	22 58 42.91	+1 15 55.95
27	7 2 33.7	8	B. A. C. 8060	−1 44.55	+ 7 43.07	22 59 33.24	+1 28 21.04

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.	
		h. m. s.	° ′ ″		
Weisse XXII. 1220	7	22 58 8.03	+0 33 13.11	α, from Santini's Cat.	Declinations from Mural Observations by Professor Yarnall.
" 1228	9	22 58 18.24	+1 0 42.13	α, Weisse's Cat.	
B. A. C. 8060	7	23 1 30.76	+1 21 59.24	α, mean Santini and B.A.C.	

PROSERPINA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉖ — *		㉖'s apparent	
				Δα	Δδ	α	δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Nov. 29	9 42 5.67	5	B. Z. 395, 92	−1 15.24	−4 54.06	4 38 34.55	+24 24 15.28
30	9 15 47.07	6	" 395, 92	−2 15.98	−5 47.36	4 37 33.83	+24 23 22.02
Dec. 7	8 41 14.08	7	" 521, 33	+0 56.39	+0 0.11	4 30 22.74	+24 15 41.97
10	8 39 12.26	10	" 521, 33	−2 4.64	−3 55.42	4 27 21.75	+24 11 46.21

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 395, 92	(8.9)	4 40 4.00	+24 29 29.13	Bessel's Zones.
" 521, 33	(8.9)	4 29 40.40	+24 16 4.73	" "

CORRIGENDUM.

Vol. IV. page 128, fourth line of Contents, *for* Elements of Euphrosyne, *read* Ephemeris of Euphrosyne.

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ON PROFESSOR AIRY'S OBJECTIONS TO PEIRCE'S CRITERION.*

By JOSEPH WINLOCK.

THE conclusion to which Professor AIRY has been led, in his endeavors to make himself acquainted with Professor PEIRCE's *Criterion for the Rejection of Doubtful Observations*, — that is, "that the whole theory is defective in its foundation, and illusory in its results," — may well surprise, not only the Astronomer Royal himself, but mathematicians generally, who are acquainted with the character of Professor PEIRCE's numerous and valuable mathematical investigations, or who have given any attention to this one.

The *Criterion* has already come into use, to some extent, in this country; it has been employed in several astronomical researches, and in its extended form, prepared by Dr. GOULD (*Astronomical Journal*, No. 83), is now used altogether in the discussion of observations in the United States Coast Survey. It might, then, be safely assumed, that American mathematicians are sufficiently aware of its correctness and value. But as it is well known that improvements in methods of calculation are slowly and cautiously adopted by practical computers, even when their utility and accuracy are unquestioned, it is but reasonable to suppose, that the adverse opinion of so eminent a mathematician as the Astronomer Royal, emphatically and authoritatively expressed, would add not a little to this natural opposition to what is new. And it might tend, in no unimportant degree, to retard the general adoption of the *Criterion*, especially among that class of astronomers who would not be sufficiently attracted to it as a theoretical discussion, to take the trouble requisite to satisfy themselves of the soundness of the theoretical basis on which it rests. For this reason, and not that I think his objections of sufficient importance, otherwise, to require an answer, I have thought I might render some service to science by calling attention to what I consider the unsoundness of his arguments, and the falsity of his conclusions.

His objections go back to the first principles of the Calculus of Probabilities, and his difficulties are confined to obvious elementary considerations, such as would present themselves at once to any one in a preliminary examination of the subject; they could not have escaped a mathematician of Professor PEIRCE's sagacity, and were no doubt readily disposed of by him before approaching the real difficulties of the problem.

An objection to which he seems to attach much importance is contained in the following paragraph: —

"It appears to me that, in the whole process to which I am alluding, there is a fault of reasoning of a vital character; namely, the assumption that we can apply the reasoning of antecedent probability to the discussion of observations which are recorded as having been actually made. In ordinary life, instances perpetually occur (some of a permanent, some of a transient character) which, considered beforehand, are in the highest degree improbable, but which, as matters of history, are absolutely certain."

If this could be urged as an objection of a vital character against the *Criterion*, it would prove equally fatal to any theory of combination of discordant observations. The Professor certainly accepts the *Method of Least Squares;* but, in using that, is he not applying a "theory of antecedent probability" to a set of observations for the purpose of obtaining a result which he receives as the most probable, although it may be at variance with the evidence of each and every one of the observations which are recorded as having been actually made?

Why should there be, *a priori*, any greater objection to approaching a series of observations with a theory of antecedent probability for the purpose of detecting abnormality in some of them, than for the purpose of ascertaining any other peculiarity or property that they may possess, whose existence or magnitude has to be received or rejected by us on an estimate of the probabilities for or against it? But we cannot speak with propriety of the residual errors as being actually made, until we know with certainty the quantity observed.

While it is true that, in ordinary life, and in matters of history, things are perpetually occurring which are beforehand in the highest degree improbable, it is equally true that, on an estimate of the probabilities against events said to have occurred, we refuse our belief in them altogether, or consider them so improbable that it would be unwise for us to take them into account, or to allow them any influence in forming our opinions or directing our actions. More especially would this be the case when the question to be decided by us in regard to them was, whether they were produced by the operation of ordinary or of extraordinary causes, which is the question in the case of doubtful observations.

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* "Letter from Professor AIRY, Astronomer Royal, to the Editor," *Astronomical Journal*, Vol. IV. pp. 137, 138.

He urges against it another argument, based on its assumed failure in a special case, — the observed zenith-distances of *Polaris*. But since he seems to have applied it here with no other data than the error of the doubtful observation, we are justified in doubting whether he has any right to pronounce this a case of failure. Nor can we attach any consequence to his assertion that it would fail in the instance which he has cited in his note, of observations for determining the figure of the earth, until it has been actually applied in accordance with its own rules and conditions.

It is not easy to see how the enumeration of the separate sources of error, in this connection, strengthens his position. If the effect of any one of them is known, the observations must first be corrected for it; if the manner of its action is known to be such that we cannot assume that the probability of an error produced by it may be expressed by the function $\frac{h}{\sqrt{\pi}} e^{-h^2 \Delta^2}$, any objection on this account against the *Criterion* would lie also against the application of the *Method of Least Squares* for any purpose; for this method supposes that the residual errors are not affected by anything inconsistent with the law of error upon which it is based. There is nothing in the *Criterion* which would prevent our using any knowledge we may have of the errors arising from different causes. When we know nothing to the contrary, we are authorized to assume, whatever may be those separate causes, whether "bad definition of the star, failure of the nervous system of the observer's eye, failure of the nervous or muscular system of the fingers, or the irregular blasts of wind on the spokes of the circle," that each one and all together produce errors in accordance with the law of error which the *Method of Least Squares* supposes, and that, therefore, the *Criterion* is applicable to them, if it has been logically deduced from that method.

But granting, in the case he has cited, all that he claims, it amounts to nothing more than this, — that the *Criterion* might reject, in an extreme case, a good observation; that it might fail to distinguish between the most improbable and an abnormal observation. Here, and throughout his paper, he seems to hold the opinion that it is just as injurious to reject a good observation as it is to retain a bad one, provided the latter is within the limit of the greatest possible chance error. In connection with the case cited above, of the zenith-distances of *Polaris*, he says: "But is it not injurious to retain such a result? I cannot say; but it is quite as probable that its retention will be beneficial." How do we know that retaining an observation affected by an error, which requires the concurrence of the maxima of all the constituent errors with the same sign, will affect the mean of a series beneficially quite as often as injuriously? Before we can be prepared to say that, in a given group, there is an even chance of this being the case, we must know the number of observations, and the number of distinct sources of error.

We have a right to expect such large errors in an extended series, where their effect is unimportant, and counterbalanced by similar errors with opposite signs; but when we find them irregularly in small groups, we have reason to fear that their effect may be prejudicial to the mean. But we are not required to use the same care to avoid the rejection of a good observation (that is, one affected only by ordinary causes of error) as the retention of a bad one. When we reject a good observation, we do not necessarily introduce error, we simply decline to use all the evidence we have, and our conclusions are of proportionally less value; but retaining one which is abnormal vitiates the result. If the observation is simply doubtful, the doubt goes to depreciate the probability of the correctness of our conclusions, and in this way has the same effect as rejecting one known to be good. Then we are not bound, as Professor AIRY contends, to be absolutely certain that extraordinary causes, such as the slip of a clamp, have operated, before we are authorized to reject; but we must reject whenever an observation is so doubtful, that retaining it makes our conclusions less reliable than they would be if its evidence had not been used. The *Criterion* not only shows us when this is the case, but, which is one of its greatest merits, it enables us to estimate how much the doubtful character of the rejected observations, even after their rejection, detracts from the weight of results obtained from the series in which they were found; and thus furnishes us the only method we have of ascertaining the probable error of conclusions based on some observations of a series of which the rest have been rejected as defective or doubtful.

Finally, he concludes, "that we can hope for no rule to guide us in the rejection of observations, and we must abandon the mathematical theory altogether, and rely upon the application of our mental reasoning to the independent examination of the special cases which may come before us." This rests on the following argument: —

The mathematical theory of probabilities fails in all questions applying to errors of extreme magnitude. In applying the theory to doubtful observations, the large errors are those under consideration; then, in such cases, we are using the failing part of the theory; and, therefore, our conclusions must necessarily be worthless.

The difficulty that arises from the fact that theory admits the possibility of errors of any magnitude in an infinitely extended series of observations, and therefore in any group, however small, regarded as a part of such series, is one of the first that presents itself in the consideration of the problem. And it seems to me that the failure referred to is, in this case, as in all others for which the *Method of Least Squares* is used, of no practical importance. It is purely theoretical; represented geometrically, — A curve which should meet a line can, theoretically, only approach it within a distance less than any assignable quantity. Nor is the fact that large errors generally occur even more frequently than the theory requires, of any consequence to our present purpose. If the quantity observed were already known with certainty, and we should propose to decide which of a small group of observations were affected by extraordinary causes, when their number was too small for us to expect the distribution of their errors to exhibit conformity to theory, and they were supposed to be taken at random from a series of indefinite extent, the failure of the theory would render impossible any satisfactory solution of the problem. And this seems to be the case that Professor Airy had in his mind when he gave up the problem. But even in this case, if the observations were to be used to determine an unknown quantity, the discordances might authorize us to doubt whether it would be safe to admit the evidence of some of them. But when, as is always the case in practice, our knowledge of the quantity observed rests on the evidence of the observations, and is affected by their errors, and we must aim to find that value from the evidence before us to which the least doubt can be attached, it is of no consequence to us that an observation is *theoretically possible*, if its discordance renders it so doubtful that it would make our result less reliable than if we rejected its evidence altogether.

The residual errors furnish us a legitimate means, and, in most cases, the only means we have, of estimating the degree of confidence due to any single observation, or to a result obtained by a combination of many; and, regarding the probability of an error as a function of its magnitude, we are enabled to find the probability of any system of residual errors, and by the comparison of the systems of errors before and after rejection in accordance with the rule of the *Criterion*, we can decide, within safe limits, whether the probability of our final result is lessened by retaining the doubtful observations, without troubling ourselves to know whether they are theoretically or even practically possible or not.

In conclusion, I will examine his *résumé*, which contains the points on which he wishes especially to insist.

1. "*The mathematical theory of probabilities fails in all questions applying to errors of extreme magnitude.*"

This failure is of no practical importance, and cannot be urged as an objection to the *Method of Least Squares*, nor to anything logically deduced from that method.

2. "*No consideration of the magnitudes of residual errors* per se *will justify us in rejecting a result.*"

Any theory of probabilities applied to observations must rest upon the principle, that the probability of any error is a function of its magnitude. No. 2, then, is equivalent to the assertion, that no consideration of the probabilities against an observation *per se* can justify us in rejecting it.

3. "*We are justified in rejecting a result only when, from the best estimate that we can form of the extent of action of the various causes which can produce error, we find that the combination of those causes of error cannot possibly produce the discordance in question;* —

4. "*And when we perceive that other causes may have intervened, whose nature is such that they cannot be recognized as occurring in the ordinary series of observations.*"

In practice it is impossible to know all the possible causes which may produce error, and we could form no estimate of the maximum or probable effect of such causes as irregular blasts of wind on the spokes of a circle, failure of the nervous or muscular system of the fingers, or of the eye, even if their effects could be separated from the others, without a consideration of the residual errors *per se.*

No. 3, then, if it could ever be a practical guide to any one, could only be used by the observer himself, before *all* the circumstances of the observations had escaped his memory; and it might then lead him right in extraordinary cases, such as that recorded of General Colby.

No. 4 adds another practical difficulty to the application of the criterion of "mental reasoning" to special cases. Taken in connection with No. 3, it serves to present in a strong light Professor Airy's positions:— that observations are not to be judged by their discordances, but by a knowledge of instrumental defects, the observer's liability to error, and extraneous accidental influences, independent of that furnished by the observations themselves; and that we must have certainty of the existence of abnormal error, not only by being convinced that no ordinary causes could have possibly produced the discordance in question, but we must, in addition to this, perceive that extraordinary influences may have intervened, before we are authorized to reject; or that, in forming our judgment in doubtful cases, we must lean to the side of error.

ON THE DETERMINATION AT THE PULKOWA OBSERVATORY OF THE COMPARISON-STARS USED WITH BIELA'S COMET.

By PROFESSOR STRUVE.

When the Imperial Academy of Sciences in St. Petersburg proposed, two years since, the discussion of the Orbit of Biela's Comet as the subject for an academic prize, the Pulkowa Observatory undertook to facilitate the investigations upon this subject by determining anew, with the Repsold Meridian-Circle, the positions of the comparison-stars used at former apparitions of the Comet prior to the year 1846. These determinations were undertaken by Dr. Sabler, and for this purpose he compiled, from the data scattered through various periodicals, a catalogue of 189 comparison-stars to be re-observed. It was unfortunately necessary to omit those used during the apparition of 1772, inasmuch as the details of the observations made at that time by Montagne and Messier are not known.*

After completing the catalogue, Dr. Sabler proceeded immediately to the work of observation; but his labors were interrupted during the summer of 1854 by his appointment to the Directorship of the Observatory at Wilna. After his departure from Pulkowa, Dr. Lindhagen continued the work, and has recently completed the following catalogue of apparent positions of the comparison-stars, together with the corresponding mean places reduced to the beginning of the year 1854. This catalogue contains the positions of 169 comparison-stars; 10 others have not been satisfactorily identified, and 10 have not yet been determined, because their right-ascensions were such as to interfere with the observation of other comparison-stars. Although, in this respect, the work cannot be considered as absolutely completed, the Pulkowa Observatory does not feel justified in longer delaying the publication of the positions now communicated.

W. STRUVE.

Pulkowa, 1855, *Dec.* $\frac{30}{18}$.

COMPARISON-STARS OF BIELA'S COMET,

OBSERVED AT PULKOWA WITH THE REPSOLD MERIDIAN-CIRCLE.

By SABLER AND LINDHAGEN.

A. *Apparition* 1805.

No.	Name of Star.	Mag.	Observer.	Date of Observation.	Observed α.	Apparent δ.	Mean place, 1854.0 α	Mean place, 1854.0 δ
					h. m. s.	° ′ ″	h. m. s.	° ′ ″
1	*Aquarii*, 359, B.	7.8	S.	1853, Nov. 27	23 32 2.56	—23 20 38.8	23 32 3.67	—23 20 24.8
			S.	1853, Dec. 24	2.68	47.9	4.12	32.5
2	*Aquarii*, 981, M.	6	S.	1853, Nov. 27	23 39 43.67	—12 43 16.8	23 39 41.56	—12 43 6.9
			S.	1853, Dec. 24	43.26	17.0	41.45	5.2
3	W. XXIII. 1006.	8	S.	1853, Nov. 27	23 49 17.67	+ 3 51 39.7	23 49 18.56	+ 3 51 13.9
			S.	1853, Dec. 24	17.43	39.4	18.60	15.3
4	4 *Ceti.*	6	S.	1853, Nov. 27	0 0 14.51	— 3 21 47.7	0 0 15.32	— 3 21 41.2
			S.	1853, Dec. 24	14.21	50.5	15.29	42.1
5	Anon.	6.7	S.	1853, Nov. 27	0 10 45.80	+10 23 43.1	0 10 46.59	+10 23 45.1
			S.	1853, Dec. 24	45.34	41.5	46.41	44.9
6	40 *Piscium.*	7	S.	1853, Nov. 28	0 12 22.93	+15 26 25.0	0 12 23.73	+15 26 25.5
			S.	1853, Dec. 29	22.44	23.3	23.58	25.2
7	Lalande, 581.	6.7	S.	1853, Nov. 27	0 19 55.07	+15 12 58.4	0 19 55.83	+15 12 58.9
			S.	1853, Dec. 24	54.81	57.5	55.85	59.0
8	46 *Piscium.*	6.7	S.	1853, Nov. 28	0 20 22.13	+18 42 24.5	0 20 22.90	+18 42 24.0
			S.	1853, Dec. 29	21.59	21.4	22.70	22.1

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* The comparison-stars for the Dorpat and Königsberg observations during the apparition of 1832, — observations which far surpass in accuracy all the others of that epoch, — were determined during the following year with great precision, by means of the excellent Meridian-Circles of these two Observatories, and consequently require no new determination; at least, in so far as they relate to these two series of observations.

No.	Name of Star.	Mag.	Observer.	Date of Observation.	Observed α.	Apparent δ.	Mean place, 1854.0.	
							α	δ
					h. m. s.	° ′ ″	h. m. s.	° ′ ″
9	Lalande, 761.	6	S.	1853, Nov. 27	0 24 52.63	+26 46 31.4	0 24 53.37	+26 46 28.8
			S.	1853, Dec. 24	52.15	28.0	53.21	25.6
10	Lalande, 1087.	7	S.	1853, Nov. 28	0 33 51.13	+23 49 41.9	0 33 51.88	+23 49 40.1
			S.	1853, Dec. 29	50.46	42.0	51.52	40.7
11	*ζ Androm.*	4	S.	1853, Nov. 27	0 39 35.75	+23 28 21.1	0 39 36.43	+23 28 19.4
			S.	1853, Dec. 24	35.47	18.6	36.43	17.1
12	Lalande, 1464.	6	S.	1853, Nov. 27	0 45 27.33	+36 37 38.3	0 45 27.95	+36 37 33.7
			S.	1853, Dec. 24	26.86	38.2	27.84	32.6
13	*μ Androm.*	3.4	S.	1853, Nov. 27	0 48 39.22	+37 42 28.6	0 48 39.82	+37 42 23.8
			S.	1853, Dec. 24	38.58	27.6	39.55	21.7
14	Lalande, 1702.	8	S.	1853, Nov. 27	0 52 16.48	+34 54 14.3	0 52 17.08	+34 54 10.1
			S.	1853, Dec. 29	16.03	13.1	17.04	8.0
15	Lalande, 1710.	8	S.	1853, Nov. 28	0 52 49.73	+35 52 26.2	0 52 50.34	+35 52 21.7
			S.	1853, Dec. 24	49.48	26.6	50.42	21.1
16	Lalande, 1847.	7	S.	1853, Nov. 27	0 56 24.11	+39 12 31.2	0 56 24.67	+39 12 26.2
			S.	1853, Dec. 29	23.44	33.1	24.45	27.0
17	Anon.	9	S.	1853, Nov. 27	1 0 16.69	+39 52 50.3	1 0 17.24	+39 52 45.2 *
			S.	1853, Dec. 24	0 59 56.64	49.9	0 59 57.54	43.2
18	*β Androm.*	2.3	S.	1853, Nov. 28	1 1 33.55	+34 50 48.7	1 1 34.12	+34 50 44.5
			S.	1853, Dec. 29	32.98	48.5	33.93	43.3
19	B. Z. 443.	7.8	S.	1853, Nov. 27	1 4 42.16	+40 52 53.4	1 4 42.68	+40 52 48.2
			S.	1853, Dec. 29	41.52	52.9	42.49	45.9

B. *Apparition* 1826.

No.	Name of Star.	Mag.	Observer.	Date of Observation.	Observed α.	Apparent δ.	Mean place, 1854.0.	
							α	δ
					h. m. s.	° ′ ″	h. m. s.	° ′ ″
20	*Arietis*, 46, B.	8.9	L.	1855, Dec. 22	1 52 43.26	+ 9 55 50.5	1 52 36.96	+ 9 55 12.1
21	Lalande, 4071.	9	L.	1855, Oct. 27	2 4 49.46	+ 9 39 7.1	2 4 43.10	+ 9 38 28.8
			L.	1855, Dec. 22	49.63	5.4	43.25	27.8
22	Piazzi II. 155.	7	L.	1855, Dec. 22	2 31 18.71	+10 0 56.7	2 31 12.15	+10 0 20.9
23	85 *Ceti.*	6	L.	1855, Dec. 22	2 34 43.26	+10 7 34.6	2 34 36.67	+10 6 59.0
24	W. II. 799.	9	L.	1855, Dec. 22	2 46 33.05	+10 43 15.0	2 46 26.40	+10 42 40.3
25	Lalande, 5616.	8	S.	1854, Feb. 13	2 54 49.21	+10 26 1.1	2 21 50.00	+10 26 3.9
			L.	1855, Dec. 22	56.79	39.2	50.07	5.4
26	Lalande, 5942.	8.9	S.	1853, Dec. 29	3 4 58.09	+10 34 56.0	3 4 58.28	+10 34 56.5
			L.	1855, Dec. 22	5 5.19	35 27.2	58.40	54.4
27	Lalande, 5945.	8.9	S.	1854, Feb. 13	3 5 5.95	+10 43 0.2	3 5 6.71	+10 43 2.7
28	Piazzi III. 67.	7.8	S.	1854, Feb. 11	3 20 37.08	+10 52 52.2	3 20 37.69	+10 52 54.2
			S.	1854, Feb. 13	37.36	53.3	38.00	55.3
29	4 *Tauri.*	5	S.	1853, Dec. 29	3 22 25.92	+10 49 56.8	3 22 26.04	+10 49 57.0
30	Lalande, 6508.	7.8	S.	1854, Feb. 11	3 24 11.46	+11 2 38.6	3 24 12.05	+11 2 40.4
			S.	1854, Feb. 13	11.76	38.8	12.38	40.7
31	*λ Tauri.*	4	S.	1854, Feb. 11	3 52 35.20	+12 4 25.6	3 52 35.63	+12 4 26.5
			L.	1855, Feb. 18	38.74	39.0	35.77	26.3
32	W. IV. 397.	7	S.	1854, Jan. 16	4 19 25.56	+10 52 50.8	4 19 25.53	+10 52 50.7
			L.	1855, Feb. 18	28.55	59.3	25.42	48.9
33	Lalande, 8498.	8	S.	1854, Feb. 13	4 22 53.70	+10 25 50.6	4 22 53.98	+10 25 51.5
			L.	1855, Feb. 19	57.00	59.8	53.87	49.8
34	88 *d Tauri.*	5	L.	1855, Feb. 18	4 27 41.44	+ 9 51 36.8	4 27 38.27	+ 9 51 27.3
			L.	1855, Mar. 1	41.16	36.0	38.17	26.7
35	Lalande, 8669.	7.8	S.	1854, Feb. 13	4 28 14.67	+11 6 31.1	4 28 14.92	+11 6 31.7
			L.	1855, Feb. 15	18.06	43.1	14.82	33.1
36	*Tauri*, 151 Lacaille.	6	S.	1854, Feb. 13	4 36 20.30	+10 52 11.9	4 36 20.50	+10 52 12.5
			S.	1854, Feb. 28	20.21	11.0	20.65	11.9

* The same ?

The first *α*, which depends only upon the transit over two threads, is probably erroneous, from a transposition of these two threads in recording. Upon this assumption the apparent *α* becomes 0h. 59m. 57s.09, and the mean *α* 1854.0 = 0h. 59m. 57s.64; consequently accordant with the second observation.

No.	Name of Star.	Mag.	Observer.	Date of Observation.	Observed α.	Apparent δ.	Mean place, 1854.0.	
							α	δ
					h. m. s.	° ′ ″	h. m. s.	° ′ ″
37	Lalande, 8943.	6	S.	1853, Dec. 29	4 37 54.96	+11 26 6.3	4 37 54.81	+11 26 5.1
			L.	1855, Feb. 18	58.08	15.0	54.82	5.6
38	W. IV. 889.	9	S.	1854, Feb. 13	4 41 22.46	+10 43 41.5	4 41 22.64	+10 43 42.0
			L.	1855, Feb. 15	25.72	53.4	22.42	44.4
39	*π² Orionis.*	4	S.	1853, Dec. 29	4 42 39.61	+ 8 38 46.7	4 42 39.43	+ 8 38 45.9
			S.	1854, Feb. 28	39.11	42.3	39.51	43.8
40	Lalande, 9281.	9	S.	1854, Feb. 13	4 41 9.13	+10 31 33.6	4 49 9.26	+10 31 34.1
			S.	1854, Feb. 28	9.10	33.9	9.47	34.7
41	*Orionis*, 43, B.	7	S.	1854, Feb. 28	4 59 41.16	+10 41 50.6	4 59 41.47	+10 41 51.2
			L.	1855, Feb. 14	44.93	57.7	41.49	50.0
42	W. V. 7.	8.9	S.	1853, Dec. 29	5 1 54.64	+10 42 12.9	5 1 54.43	+10 42 11.4
			L.	1855, Feb. 15	57.81	18.6	54.38	11.1
43	W. V. 237.	8.9	S.	1853, Dec. 29	5 11 2.62	+10 22 37.0	5 11 2.45	+10 22 35.4
			L.	1855, Feb. 19	5.85	41.1	2.42	34.3
44	W. V. 245.	9	S.	1854, Feb. 28	5 11 14.56	+10 31 22.4	5 11 14.78	+10 34 22.9
			L.	1855, Feb. 18	18.23	32.3	14.79	25.6
45	*φ′ Orionis.*	5	S.	1854, Feb. 28	5 26 48.13	+ 9 23 10.7	5 26 48.28	+ 9 23 11.4
			L.	1855, Feb. 13	52.08	14.1	48.50	8.9
46	*λ Orionis.*	3.4	L.	1855, Feb. 14	5 27 9.45	+ 9 47 59.8	5 27 5.88	+ 9 47 54.5
			L.	1855, Feb. 15	9.36	60.5	5.80	55.3
47	*φ² Orionis.*	1.5	S.	1854, Feb. 28	5 28 53.10	+ 9 12 24.6	5 28 53.24	+ 9 12 25.3
			L.	1855, Feb. 20	56.81	29.7	53.41	24.9
48	61 *μ Orionis.*	4.5	L.	1855, Feb. 19	5 51 24.75	+ 9 38 36.2	5 51 21.10	+ 9 38 33.3
			L.	1855, Feb. 20	24.72	37.7	21.08	34.9
49	*η Canis Min.*	6	S.	1854, Mar. 13	7 20 10.89	+ 7 14 7.3	7 20 10.64	+ 7 14 8.2
			S.	1854, Mar. 25	11.22	5.3	11.15	6.2
50	Piazzi VII. 158.	6.7	S.	1854, Mar. 13	7 28 48.41	+ 6 10 51.0	7 28 48.11	+ 6 10 52.3
			S.	1854, Mar. 25	48.25	49.0	48.13	50.2
51	B. Z. 404. dpl. maj. præc.	8.9	L.	1855, Feb. 19	5 42 38.53	+36 15 27.7	5 42 34.14	+36 15 15.4
			L.	1855, Mar. 1	38.49	28.4	34.29	15.6
52	W. XI. 547.	8	S.	1854, Mar. 25	11 31 21.79	— 6 47 37.2	11 31 23.85	— 6 47 30.9
			L.	1855, Mar. 22	27.98	57.6	23.81	30.6
53	W. XI. 887.	7	S.	1854, Mar. 25	11 51 42.38	— 9 40 0.8	11 51 41.43	— 9 39 54.3
			L.	1855, Mar. 22	45.60	17.8	41.42	50.2
54	W. XI. 914.	7	L.	1855, Mar. 27	11 53 19.23	— 9 37 20.9	11 53 15.03	— 9 36 52.8
			L.	1855, Apr. 1	19.16	17.8	14.94	49.3
55	W. XI. 954.	8	S.	1854, Mar. 25	11 55 31.82	— 9 56 28.3	11 55 30.87	— 9 56 21.7
			L.	1855, Mar. 31	35.24	47.8	31.02	19.4
56	W. XI. 977.	9	L.	1855, Mar. 22	11 57 19.21	—10 19 10.3	11 57 15.02	—10 18 42.6
			L.	1855, Mar. 30	19.31	11.6	15.09	43.2
57	W. XII. 110.	8	S.	1854, Mar. 25	12 8 0.21	—13 15 42.5	12 7 59.26	—13 15 35.9
			L.	1855, Mar. 22	3.66	16 3.4	59.47	35.6
58	W. XII. 116.	8	L.	1855, Mar. 27	12 8 23.08	—13 0 46.7	12 8 18.86	—13 0 18.4
			L.	1855, Mar. 30	23.24	47.3	19.01	18.7
59	W. XII. 172.	8	S.	1854, Mar. 25	12 11 29.59	—12 43 55.3	12 11 28.63	—12 43 48.7
			L.	1855, Mar. 31	33.08	44 16.0	28.84	47.2
			L.	1855, Apr. 1	32.98	16.9	28.73	48.0
60	B. A. C. 4157.	6	L.	1855, Mar. 22	12 13 27.87	—12 45 48.5	12 13 23.67	—12 45 20.7
			L.	1855, Mar. 27	27.86	49.0	23.63	20.6
61	Henderson.	7	L.	1855, Apr. 1	13 52 26.19	—25 33 25.1	13 52 21.68	—25 32 59.1
62	*π Hydræ.*	4.5	L.	1855, Apr. 1	13 58 8.56	—25 59 6.9	13 58 4.03	—25 58 41.2

C. *Apparition* 1846.

No.	Name of Star.	Mag.	Observer.	Date of Observation.	Observed α.	Apparent δ.	Mean place, 1854.0.	
							α	δ
					h. m. s.	° ′ ″	h. m. s.	° ′ ″
63	37 *Pegasi.*	6	L.	1854, Sept. 11	22 22 37.59	+ 3 41 42.5	22 22 35.09	+ 3 41 28.7
			L.	1854, Oct. 10	37.41	44.0	35.07	29.0
64	Piazzi XXII. 169.	7	L.	1854, Sept. 14	22 31 28.62	+ 3 46 33.7	22 31 26.12	+ 3 46 19.6
			L.	1854, Oct. 14	28.47	35.4	26.10	20.0

No.	Name of Star.	Mag.	Observer.	Date of Observation.	Observed α.	Apparent δ.	Mean place, 1854.0.	
							α	δ
					h. m. s	° ′ ″	h. m. s	° ′ ″
65	W. XXII. 772.	8	L.	1854, Oct. 11	22 36 26.98	+ 3 6 48.1	22 36 21.56	+ 3 6 32.7
			L.	1854, Oct. 14	27.06	48.1	21.66	33.0
66	Wien *a.*	10	L.	1854, Oct. 20	22 53 26.12	+ 1 1 59.9	22 53 23.78	+ 1 1 44.3
			L.	1854, Nov. 24	25.70	61.6	23.62	47.3
67	W. XXII. 1228.	9	L.	1854, Sept. 14	22 58 2.29	+ 0 58 59.1	22 57 59.73	+ 0 58 44.3
			L.	1854, Oct. 10	2.22	59 2.7	59.70	47.0
			L.	1855, Sept. 22	5.57	20.6	59.69	45.0
68	A *Piscium.*	5	L.	1854, Oct. 14	23 1 14.69	+ 1 20 18.8	23 1 12.18	+ 1 20 2.9
			L.	1854, Oct. 15	14.70	16.6	12.20	0.7
69	Greenwich i^1.		L.	1854, Sept. 14	23 5 40.86	+ 0 51 56.5	23 5 38.30	+ 0 51 11.4 *
			L.	1855, Sept. 23	44.16	53 15.0	38.26	52 38.8 *
70	W. XXIII. 98.	8.9	L.	1854, Oct. 15	23 6 2.83	+ 0 8 31.2	23 6 0.30	+ 0 8 15.3
			L.	1854, Nov. 24	2.58	30.0	0.42	15.5
71	Piazzi XXIII. 21.	8	L.	1854, Oct. 10	23 8 12.89	+ 0 31 10.1	23 8 10.33	+ 0 30 51.1
			L.	1854, Oct. 11	12.89	8.1	10.34	52.4
72	*κ^1 Piscium.*	5	L.	1854, Oct. 11	23 19 29.41	+ 0 27 40.7	23 19 26.82	+ 0 27 24.3
			L.	1854, Oct. 20	29.42	41.0	26.88	24.7
73	*κ^2 Piscium.*	5	L.	1854, Oct. 15	23 19 48.59	+ 0 19 33.0	23 19 46.02	+ 0 19 16.6
			L.	1854, Nov. 24	48.23	30.8	46.00	15.8
74	W. XXIII. 449.	8.9	L.	1854, Sept. 14	23 22 29.97	+ 0 21 49.9	23 22 27.40	+ 0 21 34.3
			L.	1854, Oct. 10	29.88	50.3	27.28	33.8
75	Washington *a.*		L.	1854, Oct. 10	23 54 39.90	— 0 23 34.3	23 54 37.22	— 0 23 51.6
			L.	1854, Oct. 11	40.13	36.0	37.45	53.4
76	W. XXIII. 1205.	8	L.	1854, Oct. 14	23 58 41.90	— 0 41 11.9	23 58 39.22	— 0 41 29.3
			L.	1854, Oct. 20	41.90	12.0	39.23	29.3
77	Washington *c.*		L.	1854, Nov. 24	23 59 42.32	— 0 28 8.1	23 59 39.86	— 0 28 24.0
			L.	1855, Sept. 11	45.71	27 47.3	39.86	25.5
			L.	1855, Sept. 22	45.82	46.0	39.83	24.8
78	H. C. p. 139.		L.	1854, Oct. 11	0 7 23.83	— 1 6 35.3	0 7 21.12	— 1 6 52.9
			L.	1854, Oct. 14	23.90	34.2	21.19	51.8
79	W. O. 246.	9	L.	1854, Oct. 10	0 14 25.10	— 0 48 36.3	0 14 22.39	— 0 48 54.1
			L.	1854, Oct. 11	25.24	37.3	22.53	55.1
80	10 *Ceti.*	6	L.	1854, Oct. 14	0 19 10.88	— 0 51 14.0	0 19 8.15	— 0 51 31.9
			L.	1854, Oct. 20	10.80	14.1	8.07	31.9
81	W. O. 368.	8	L.	1854, Oct. 11	0 22 24.91	— 1 7 28.5	0 22 22.18	— 1 7 46.4
			L.	1854, Oct. 15	24.95	28.7	22.22	46.6
82	W. O. 425.	9	L.	1854, Oct. 10	0 25 23.77	— 1 14 46.7	0 25 21.04	— 1 15 4.7
			L.	1854, Oct. 14	23.87	48.7	21.13	6.7
83	B. A. C. 147.	6.7	L.	1854, Oct. 11	0 28 6.00	— 1 18 11.2	0 28 3.27	— 1 18 29.3
			L.	1854, Oct. 15	5.88	12.4	3.14	30.4
84	W. O. 515.	7	L.	1854, Oct. 14	0 30 39.32	— 1 18 7.9	0 30 36.57	— 1 18 26.0
			L.	1855, Sept. 22	42.57	17 45.85	36.63	25.5
85	W. O. 607.	9	L.	1854, Oct. 10	0 35 11.25	— 1 8 29.7	0 35 8.51	— 1 8 47.9
			L.	1854, Oct. 11	11.28	28.3	8.51	46.5
86	W. O. 664.	9	L.	1854, Oct. 14	0 38 30.00	— 1 35 53.0	0 38 27.24	— 1 36 11.2
			L.	1854, Oct. 15	29.93	51.1	27.17	9.3
87	W. O. 674.	9	L.	1855, Sept. 11	0 39 11.49	— 1 37 24.3	0 39 5.70	— 1 38 3.6
			L.	1855, Sept. 22	11.88	24.0	5.95	3.8
			L.	1855, Sept. 23	11.83	22.5	5.89	2.3
88	W. O. 712.	8	L.	1854, Oct. 10	0 40 54.86	— 1 16 50.0	0 40 52.12	— 1 17 8.3
			L.	1854, Oct. 11	54.86	51.8	52.11	10.1
89	W. O. 762.	9	L.	1854, Oct. 14	0 44 12.98	— 1 16 36.9	0 44 10.22	— 1 16 55.3
			L.	1854, Oct. 15	12.93	36.2	10.17	54.5
90	20 *Ceti.*	6	L.	1855, Sept. 11	0 45 38.61	— 1 55 37.8	0 45 32.87	— 1 56 17.2
			L.	1855, Sept. 22	38.78	37.9	32.86	17.8
			L.	1855, Sept. 23	38.79	36.8	32.86	16.7
91	Greenwich i^3.		L.	1854, Oct. 10	0 53 24.82	— 1 48 16.4	0 53 22.07	— 1 48 34.9
			L.	1854, Oct. 11	24.75	16.0	21.99	34.5
92	Anon.	9.10	L.	1855, Sept. 11	1 9 17.08	— 2 23 29.5	1 9 11.37	— 2 24 9.0

(*To be continued.*)

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* Doubtless a mistake of one division in noting the index-reading in one of the observations, probably the second.

FROM A LETTER OF MR. OTTO STRUVE TO THE EDITOR.

Pulkowa, $\frac{\text{1856, } \textit{Jan. 7.}}{\text{1855, } \textit{Dec. 26.}}$

My father has within a short time completed the printing of the first part of his description of the measurement of the great meridian arc, and prepared the greater portion of the text for the second volume. My time has been greatly interrupted by various kinds of work, so that I have had very little at my disposal for scientific investigation. Nevertheless I have succeeded in accomplishing something relative to parallaxes. From a comparatively small number of observations, I have found the following values for some: —

For *α Aurigæ*,	$\pi = +0''.305$ with the prob. error,			$0''.043$
" *η Cassiopeiæ*,	$+0.154$	"	"	0.045
" *μ Cassiopeiæ*,	$+0.342$	"	"	0.052

This parallax makes itself especially manifest in the case of *μ Cassiopeiæ*. The number of the observations is, however, only 16, and this alone is the source of the somewhat greater value of the probable error.

OTTO STRUVE.

PLANET-CIRCULARS.

The new planet was detected by Mr. Bruhns, on the 20th of January, at the Observatory of Berlin, and the following place was observed: —

	Mean Berlin Time.	㊳'s apparent α	㊳'s apparent δ
1856, Jan. 20,	$8^{h.}\ 33^{m.}\ 29^{s.}$	$128°\ 6'\ 17''.5$	$+17°\ 19'\ 5''.2$

By bright moonlight it was rather dim, and below the 10th magnitude.

Mr. Pape, now in the Observatory at Altona as computer for the Danish measurement of a degree, has calculated, from the above observation and that made in Paris on the 12th of January, a preliminary orbit, and from this the following small Ephemeris, which may prove useful in searching for the planet in the succeeding days.

EPHEMERIS.

$0^{h.}$ Berlin.

1856.	㊳ α h. m. s.	㊳ δ ° ′	Log Δ
Jan. 21	8 28 41	+17 18.0	0.2367
25	8 27 40	17 17.7	
26	8 26 38	17 17.4	
27	8 25 37	17 17.1	
28	8 24 36	17 16.8	0.2368
29	8 23 36	17 16.5	
30	8 22 36	+17 16.2	
Jan. 31	8 21 35	+17 15.9	
Feb. 1	8 20 35	17 15.6	0.2380
2	8 19 35	17 15.3	
3	8 18 35	17 15.0	
4	8 17 35	17 14.7	
5	8 16 35	+17 14.5	0.2404

No notice was received of the first discovery of this planet by M. Chacornac, on the 12th of January.

Cambridge, 1856, *Feb.* 21.

Mr. Le Verrier announces, under date of Feb. 8, that Mr. Chacornac discovered at $13^{h.}\ 7^{m.}$ a new planet of the 8th or 9th magnitude.

α	δ
$11^{h.}\ 21^{m.}\ 50^{s.}$	$+4°\ 58'.2$
Hourly motion in $\alpha = -1^{s}.4$.	Hourly motion in δ small.

The planet ㊳ discovered on the 12th of January will bear the name of *Leda*.

B. A. GOULD, Jr.

Cambridge, 1856, *March* 5.

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On Professor Airy's Objections to Peirce's Criterion, by Joseph Winlock.
On the Determination at the Pulkowa Observatory of the Comparison-Stars used with Biela's Comet, by Professor Struve.
Comparison-Stars of Biela's Comet, observed at Pulkowa with the Repsold Meridian-Circle, by Sabler and Lindhagen.
From a Letter of Mr. Otto Struve to the Editor.
Planet-Circulars.

CAMBRIDGE: METCALF AND COMPANY, PRINTERS TO THE UNIVERSITY.

THE
ASTRONOMICAL JOURNAL.
No. 92.

VOL. IV. CAMBRIDGE, 1856, APRIL 26. NO. 20.

COMPARISON-STARS OF BIELA'S COMET,

OBSERVED AT PULKOWA WITH THE REPSOLD MERIDIAN-CIRCLE.

By SABLER AND LINDHAGEN.

(*Concluded from page* 151.)

No.	Name of Star.	Mag.	Observer.	Date of Observation.	Observed α.	Apparent δ.	Mean place, 1854.0.	
							α	δ
					h. m. s.	° ′ ″	h. m. s.	° ′ ″
93	W. I. 225.	9	L.	1855, Sept. 22	1 14 28.17	— 2 45 7.6	1 14 22.30	— 2 45 47.7
			L.	1855, Sept. 23	28.11	7.0	22.23	47.1
94	B. Z. 136.		L.	1854, Nov. 24	1 20 38.17	— 2 47 20.3	1 20 35.31	— 2 47 36.8
			L.	1855, Sept. 22	41.14	46 55.3	35.29	35.3
95	Anon.	9.10	L.	1854, Oct. 14	1 23 53.91	— 3 4 55.0	1 23 51.15	— 3 5 13.9
			L.	1855, Sept. 23	56.98	35.5	51.12	15.5
			L.	1855, Oct. 1	56.97	32.3	51.00	12.4
96	W. I. 594.	8	L.	1854, Oct. 14	1 33 24.46	— 3 21 22.7	1 33 21.67	— 3 21 41.7
			L.	1854, Nov. 24	24.63	22.9	21.74	39.3
97	W. I. 690.	8	L.	1854, Oct. 11	1 38 0.30	— 3 53 55.6	1 37 57.54	— 3 51 14.8
			L.	1855, Jan. 16	37 59.94	60.5	57.45	12.7
98	W. I. 725.	8	L.	1854, Nov. 24	1 40 11.32	— 3 38 11.5	1 40 8.41	— 3 38 27.9
			L.	1855, Sept. 23	14.19	37 46.2	8.38	26.0
99	W. I. 790.	8	L.	1854, Oct. 11	1 44 14.39	— 3 21 22.4	1 44 11.61	— 3 21 41.6
			L.	1854, Oct. 14	14.25	22.8	11.47	41.9
100	W. I. 813.	9	L.	1855, Sept. 22	1 45 29.00	— 3 49 48.3	1 45 23.22	— 3 50 28.0
			L.	1855, Sept. 23	29.04	47.9	23.24	27.7
101	W. I. 924.	9	L.	1854, Nov. 24	1 52 16.87	— 4 13 18.2	1 52 13.91	— 4 13 34.5
			L.	1855, Sept. 22	20.01	12 55.5	14.24	35.1
102	W. I. 942.	7.8	L.	1855, Sept. 23	1 52 58.52	— 4 3 59.9	1 52 52.75	— 4 4 39.5
			L.	1855, Oct. 1	58.49	61.1	52.57	40.7
			L.	1855, Dec. 1	58.94	65.2	52.70	41.1
103	W. I. 1069.	8	L.	1854, Nov. 24	1 59 41.64	— 4 54 36.8	1 59 41.66	— 4 54 52.9
			L.	1855, Sept. 22	47.26	14.9	41.54	54.4
104	W. II. 162.	9	L.	1854, Nov. 24	2 11 8.83	— 5 0 19.1	2 11 5.82	— 5 0 35.2
			L.	1855, Oct. 27	12.02	4 59 57.1	5.85	35.1
105	W. II. 168.	8	L.	1855, Jan. 16	2 11 14.51	— 5 32 30.9	2 11 11.83	— 5 32 42.1
			L.	1855, Oct. 1	17.65	4.8	11.82	43.9
106	71 *Ceti.*	6	L.	1855, Sept. 22	2 17 41.52	— 3 25 58.7	2 17 35.81	— 3 26 37.3
			L.	1855, Oct. 1	41.55	57.8	35.71	36.5
107	W. II. 288.	9	L.	1855, Jan. 16	2 17 50.85	— 5 24 23.1	2 17 48.16	— 5 24 34.2
			L.	1855, Oct. 27	54.29	23 55.7	48.13	33.4
			L.	1855, Dec. 1	54.57	59.7	48.27	34.1
108	W. II. 388.	7.8	L.	1855, Sept. 22	2 23 14.33	— 5 40 19.5	2 23 8.70	— 5 40 58.3
			L.	1855, Oct. 1	14.50	20.8	8.70	59.6
109	W. II. 412. dpl. bor.	8.9	L.	1855, Jan. 16	2 26 53.77	— 6 16 36.3	2 26 51.03	— 6 16 47.0
			L.	1855, Oct. 27	57.01	12.4	50.87	49.7
			L.	1855, Dec. 1	57.36	17.5	51.06	51.3
110	Anon.		L.	1855, Jan. 16	2 36 47.59	— 6 37 45.2	2 36 44.80	— 6 37 55.6

No	Name of Star.	Mag.	Observer.	Date of Observation.	Observed α.	Apparent δ.	Mean place, 1854 0. α	Mean place, 1854 0. δ
					h. m. s.	° ′ ″	h. m. s.	° ′ ″
111	W. II. 689.	8	L.	1855, Dec. 22	2 40 4.59	— 6 22 30.9	2 39 58.32	— 6 23 1.5
112	Vienna c^2.		L.	1855, Oct. 1	2 41 19.82	— 6 20 21.98	2 41 14.09	— 6 20 59.9
113	W. II. 742.	8	L.	1855, Dec. 1	2 43 14.07	— 7 24 13.3	2 43 7.75	— 7 24 45.8
114	W. II. 816.	9	L.	1855, Oct. 1	2 47 11.59	— 6 53 44.3	2 47 5.89	— 6 54 21.9
115	W. II. 970.	7	L.	1855, Oct. 1	2 55 1.81	— 7 3 26.2	2 54 56.15	— 7 4 3.5
116	W. II. 993.	9	L.	1855, Dec. 1	2 56 23.28	— 7 42 13.2	2 56 16.94	— 7 42 44.7
117	W. III. 90.	9	L.	1854, Nov. 24	3 5 28.11	— 8 11 47.4	3 5 25.00	— 8 12 2.7
			L.	1855, Oct. 1	30.65	28.2	24.97	5.0
118	Anon.	9	L.	1855, Jan. 16	3 7 19.66	— 7 43 20.4	3 7 16.73	— 7 43 29.7
119	W. III. 178.	9	L.	1855, Oct. 1	3 10 26.92	— 8 10 2.2	3 10 21.34	— 8 10 38.7
120	W. III. 278.	7	L.	1854, Nov. 24	3 16 13.11	— 8 18 16.4	3 16 9.98	— 8 18 31.5
			L.	1855, Oct. 1	15.66	17 55.4	10.11	31.5
121	W. III. 325.	8	L.	1855, Jan. 16	3 18 41.31	— 8 43 33.2	3 18 38.33	— 8 43 41.8
			L.	1855, Dec. 22	44.77	12.9	38.43	39.8
122	Greenwich i^7.		L.	1854, Nov. 24	3 24 0.11	— 8 36 24.4	3 23 56.98	— 8 36 39.4
			L.	1855, Oct. 1	2.71	3.2	57.21	38.9
123	W. III. 456.	8	L.	1855, Jan. 16	3 25 22.41	— 9 5 24.2	3 25 19.41	— 9 5 32.5
124	W. III. 442.	8	L.	1855, Dec. 22	3 25 2.21	— 8 19 54.5	3 24 55.84	— 8 20 20.9
125	Anon.		L.	1855, Oct. 1	3 30 59.17	— 8 57 56.2	3 30 53.71	— 8 58 31.4
126	W. III. 623.	7	L.	1855, Jan. 16	3 33 10.52	— 9 30 47.5	3 33 7.49	— 9 30 55.4
			L.	1855, Dec. 22	13.82	30.6	7.46	56.0
127	W. III. 746.	8	L.	1854, Nov. 24	3 38 57.64	— 9 27 48.9	3 38 54.50	— 9 28 3.6
			L.	1855, Oct. 1	59.88	30.8	54.47	5.5
128	W. III. 758.	8.9	L.	1855, Jan. 16	3 39 38.53	— 9 53 50.6	3 39 35.40	— 9 53 58.2
			L.	1855, Dec. 22	41.77	35.1	35.41	59.8
129	W. III. 924.	7	L.	1855, Feb. 20	3 47 37.34	— 9 57 7.4	3 47 34.73	— 9 57 12.6
			L.	1855, Oct. 1	39.97	56 41.0	34.61	15.0
130	W. III. 965.	7	L.	1855, Dec. 22	3 49 44.33	—10 10 21.85	3 49 38.04	—10 10 49.2
131	W. III. 1116.	8	L.	1855, Jan. 16	3 57 31.14	—10 38 10.2	3 57 28.01	—10 38 16.9
			L.	1855, Feb. 15	30.75	8.0	28.02	12.6
132	W. IV. 114.	7.8	L.	1855, Jan. 16	4 6 36.48	—10 45 35.2	4 6 33.32	—10 45 41.5
			L.	1855, Feb. 13	36.14	37.0	33.34	41.2
133	Lalande, 8431.	7	L.	1855, Jan. 16	4 20 57.60	—11 27 11.4	4 20 54.39	—11 27 16.9
			L.	1855, Feb. 20	57.38	12.6	54.64	15.5
134	Lalande, 8479.	7.8	L.	1855, Feb. 13	4 22 3.95	—11 22 52.6	4 22 1.08	—11 22 55.7
			L.	1855, Dec. 22	7.46	35.5	1.07	55.4
135	W. IV. 776.	9	L.	1855, Feb. 13	4 35 21.85	—11 55 32.1	4 35 18.93	—11 55 34.3
			L.	1855, Feb. 14	21.93	32.5	19.02	34.7
136	W. IV. 1180.	8	L.	1855, Feb. 14	4 53 11.90	—12 45 22.3	4 53 8.92	—12 45 23.2
			L.	1855, Feb. 15	11.81	21.6	8.85	22.4
137	*κ Leporis.*	4.5	L.	1855, Feb. 19	5 6 32.48	—13 7 6.9	5 6 29.53	—13 7 6.5
138	W. V. 187.	8	L.	1855, Feb. 20	5 8 40.01	—12 59 14.8	5 8 37.06	—12 59 14.3
			L.	1855, Mar. 1	39.82	15.8	37.09	14.9
139	W. V. 419.	7	L.	1855, Feb. 13	5 18 58.79	—13 15 49.5	5 18 55.69	—13 15 48.7
			L.	1855, Feb. 14	58.88	48.0	55.79	47.1
140	W. V. 1143.	8.9	L.	1855, Feb. 13	5 44 57.74	—13 50 45.2	5 44 54 54	—13 50 42.6
			L.	1855, Feb. 14	58.01	46.9	54.82	41.2
141	W. V. 1146.	8.9	L.	1855, Feb. 15	5 45 3.86	—13 56 24.3	5 45 0.69	—13 56 21.5
			L.	1855, Feb. 20	3.80	23.8	0.70	20.6
142	*η Leporis.*	4.5	L.	1855. Feb. 15	5 49 48.64	—14 11 56.3	5 49 45.45	—14 11 53.1
143	W. V. 1500.	8	L.	1855, Feb. 14	5 58 17.36	—14 6 57.0	5 58 14.12	—14 6 53.3
			L.	1855. Feb. 15	17.26	55.3	14.04	51.5
144	W. V. 1539.	8	L.	1855, Feb. 18	6 1 18.16	—14 14 48.1	6 1 14.97	—14 14 43.8
145	W. VI. 44.	7.8	L.	1855, Feb. 13	6 2 33.39	—14 2 46.3	6 2 30.12	—14 2 42.5
			L.	1855, Feb. 14	33.50	45.7	30.24	41.8
146	W. VI. 528.	8	L.	1855, Feb. 15	6 17 50 21	—14 45 40.1	6 17 46.92	—14 45 34.9
			L.	1855, Mar. 1	49.98	40.1	46.89	33.7
147	W. VI. 544.	8	L.	1855, Feb. 14	6 18 26.63	—14 25 41.1	6 18 23.32	—14 25 36.0
			L.	1855, Feb. 18	26.50	40.0	23.24	34.5
148	W. VI. 809.	8	L.	1855, Feb. 15	6 26 44.07	—14 42 32.4	6 26 40.74	—14 24 26.5
			L.	1855, Feb. 18	43 85	32.3	40.56	26.2

No.	Name of Star.	Mag.	Observer.	Date of Observation.	Observed α.	Apparent δ.	Mean place, 1854.0. α	Mean place, 1854.0. δ
					h. m. s.	° ′ ″	h. m. s.	° ′ ″
149	W. VI. 990.	6	L.	1855, Feb. 15	6 32 39.68	—14 1 14.7	6 32 36.31	—14 1 8.7
			L.	1855, Mar. 1	39.55	15.1	36.38	7.7
150	11 *Canis Maj.*	6	L.	1855, Feb. 18	6 40 14.91	—14 16 28.2	6 40 11.55	—14 16 21.2
			L.	1855, Mar. 1	14.79	30.2	11.59	22.2
151	W. VI. 1291.	6	L.	1855, Feb. 19	6 42 23.83	—14 59 9.1	6 42 20.49	—14 59 1.7
			L.	1855, Mar. 22	23.35	9.4	20.51	0.1
152	W. VI. 1351.	8	L.	1855, Feb. 15	6 41 11.71	—14 31 35.3	6 41 8.31	—14 31 28.4
			L.	1855, Feb. 20	11.62	34.8	8.28	27.3
153	Piazzi VI. 328.	8	L.	1855, Feb. 15	6 58 57.41	—14 39 22.0	6 58 53.99	—14 39 14.0
			L.	1855, Feb. 18	57.51	21.3	54.09	13.0
154	W. VII. 93.	8	L.	1855, Feb. 15	7 3 45.43	—14 32 5.0	7 3 1.96	—14 31 56.7
			L.	1855, Feb. 18	45.62	3.8	2.18	55.2
155	W. VII. 290.	9	L.	1855, Feb. 19	7 9 38.26	—14 36 20.8	7 9 34.81	—14 36 11.6
			L.	1855, Feb. 20	38.20	20 5	34.76	11.2
156	W. VII. 316.	7	S.	1854, Mar. 25	7 10 25.71	—14 35 39.6	7 10 25.71	—14 35 32.0
			L.	1855, Feb. 18	29.37	39.2	25.90	30.1
			L.	1855, Mar. 1	28.95	41.1	25.62	30.8
			L.	1855, Mar. 22	28.71	39.5	25.71	27.9
157	Vienna, Washington.		L.	1855, Feb. 13	7 18 30.04	—14 36 8.1	7 18 26.51	—14 35 59.1
			L.	1855, Feb. 15	29.91	8.1	26.39	58.9
			L.	1855, Feb. 18	30.02	8.0	26.53	58.4
158	W. VII. 835.	6	L.	1855, Feb. 15	7 27 9.04	—14 12 52.0	7 27 5.49	—14 12 42.2
			L.	1855, Mar. 1	8.95	54.3	5.41	42.8
159	W. VII. 871.	9	L.	1855, Feb. 19	7 28 17.07	—14 38 10.4	7 28 13.55	—14 37 59,9
			L.	1855, Feb. 20	16.98	7.5	13.47	56.9
			L.	1855, Mar. 22	16.42	10.5	13.33	57.4
160	B. A. C. 2538.	6	L.	1855, Feb. 15	7 33 46.20	—14 55 51.7	7 33 42.64	—14 55 41.4
			L.	1855, Feb. 18	46.23	54.0	42.69	43.3
161	Anon.	8.9	L.	1855, Feb. 19	7 34 44.34	—14 29 8.3	7 34 40.80	—14 29 57.4
			L.	1855, Feb. 20	44.43	8.0	40.88	57.0
162	W. VII. 1182.	7	L.	1855, Feb. 13	7 38 49.90	—14 20 32.8	7 38 46.30	—14 20 22.6
	dpl. austr. sequ.		L.	1855, Feb. 14	49.93	30.4	46.33	20.0
			L.	1855, Mar. 22	49.33	34.3	46.17	20.4
163	Anon.		S.	1854, Mar. 25	7 59 36.65	—12 42 10.3	7 59 36.38	—12 42 3.5
			L.	1855, Mar. 31	39.45	16.7	36.29	1.1
164	Lalande, 17647.	8	L.	1855, Mar. 1	8 48 53.41	—13 29 25.0	8 48 49.67	—13 29 8.0
			L.	1855, Mar. 27	53.04	27.8	49.57	8.3
165	W. VIII. 1276.	8	S.	1854, Mar. 25	8 49 18.58	—13 21 2.4	8 49 18.09	—13 20 55.6
			L.	1855, Mar. 31	21.31	14.2	17.92	54.4
			L.	1855, Apr. 1	21.50	15.8	18.10	56.0
166	W. VIII. 1282.	9	S.	1854, Apr. 6	8 49 35.04	—13 22 36.3	8 49 31.72	—13 22 28.2
	dpl. austr. sequ.							
167	Anon.	9	L.	1855, Mar. 22	8 50 1.38	—13 8 40.5	8 49 57.81	—13 8 21.3
			L.	1855, Mar. 30	1.41	39.6	57.97	19.9
168	W. IX. 488.	9	S.	1854, Apr. 6	9 22 47.20	—12 5 57.6	9 22 46.72	—12 5 50.5
			S.	1854, Apr. 8	47.43	59.2	46.97	52.0
			L.	1855, Mar. 22	50.60	71.8	46.89	50.6
169	W. IX. 868.	8	S.	1854, Apr. 6	9 39 41.68	—11 16 2.1	9 39 41.13	—11 15 55.1
			S.	1854, Apr. 8	41.81	1.6	41.31	54.5
			L.	1855, Mar. 1	45.20	13.2	41.31	53.3

OBSERVATIONS OF PARTHENOPE, PSYCHE, ATALANTA, FIDES, LEDA, THE THIRTY-NINTH ASTEROID, AND COMET 1855, III.

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By JAMES FERGUSON.

[Communicated by Lieutenant Maury. — Corrected for refraction.]

PARTHENOPE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑪ — * $\Delta\alpha$	⑪ — * $\Delta\delta$	⑪'s apparent α	⑪'s apparent δ
1855	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Oct. 16	10 31 57.0	5	Weisse III. 752	—0 5.77	— 1 39.36	3 39 21.60	+12 1 57.93
17	10 16 1.2	10	" 752	—0 42.23	— 5 14.59	3 38 45.15	11 58 22.67
18	10 1 15.1	11	" 752	—1 20.40	— 8 54.58	3 38 6.99	11 54 42.64
Nov. 13	9 42 48.7	10	" 233	+1 25.92	+12 2.94	3 14 55.40	10 18 40.37
19	9 40 12.9	11	" 233	+0 26.26	+ 8 58.88	3 13 55.76	10 15 36.44
22	9 13 25.3	12	" 98	+0 1.33	— 0 28.28	3 6 13.07	9 51 33.09
23	9 3 32.6	10	" 98	—0 53.16	— 2 34.46	3 5 18.58	+ 9 52 27.67

Adopted Mean Places, 1860.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse III. 752	9	3 39 40.92	+12 4 16.50	Weisse's Catalogue.
" 233	8.9	3 13 42.32	10 7 24.27	" "
" 98	9	3 6 24.49	+ 9 55 49.12	α Weisse Cat. δ Wash. Mural, Prof. Yarnall.

PSYCHE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑯ — * $\Delta\alpha$	⑯ — * $\Delta\delta$	⑯'s apparent α	⑯'s apparent δ
1855.	h. m. s.			m s.	′ ″	h. m. s.	° ′ ″
(1) Nov. 14	10 30 14.6	11	B. A. C. 1350	+0 14.42	— 6 14.16	4 15 24.02	+16 20 9.02
22	9 54 32.8	10	B. Z. 330, 7	—0 16.76	— 8 26.21	4 8 20.34	15 59 48.48
23	9 43 25.7	8	" 330, 7	—1 10.52	+ 5 57.01	4 7 26.59	15 57 19.26
Dec. 5	8 47 39.1	5	Rümker 1079	—0 38.90	+10 52.25	3 56 54.24	15 31 33.05
		5	" 1084	—1 12.01	+13 12.50	3 56 54.03	15 31 37.51
6	8 19 40.0	5	" 1079	—1 27.50	+ 9 8.40	3 56 5.64	15 29 49.18
		5	" 1084	—2 0.45	+11 28.27	3 56 5.59	+15 29 53.20

Adopted Mean Places, 1860.0, of Comparison-Stars.

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. A. C. 1350	6	4 15 23.16	+16 26 50.98	B. A. Cat. and Rümker's Catalogue.
B. Z. 330, 7	7	4 8 50.46	15 51 52.13	Bessel's Zones and Rümker.
Rümker 1079	7.8	3 57 46.30	15 21 14.35	α Rümker ; δ Wash. Mural, Prof. Yarnall.
" 1084	7.8	3 58 19.18	+15 18 58.40	

(1) At this observation, *Psyche* had a marked purple color not noticed at the subsequent comparisons.

ATALANTA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㊱ — *		㊱'s apparent	
				Δ α	Δ δ	α	δ
1855.	h. m. s.			m s.	′ ″	h. m. s.	° ′ ″
Dec. 1	6 37 25.94	8	Weisse XXIII. 47	—0 47.31	— 4 27.92	23 3 4.61	+2 17 48.72
6	6 40 33.10	6	" 177	—1 35.85	19 21.71	23 8 4.45	3 21 11.61
		6	" 183	—1 53.90	18 41.69	23 8 4.33	3 21 10.74
7	7 0 34.3	5	" 177	—0 31 02	6 17.56	23 9 9.19	3 34 15.76
		5	" 183	—0 49.22	5 38.20	23 9 9.01	3 31 11.20
11	8 6 36.5	6	B. A. C. 8127	+0 42.02	8 51.23	23 13 41.50	4 26 51.05
18	6 41 20.2	5	Weisse XXIII. 524	—2 36.03	—18 19.29	23 22 16.56	+5 59 10.98

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XXIII. 47	9	23 4 4.93	+2 23 37.95	Weisse's Catalogue.
" 177	9	23 9 53.22	3 41 51.81	" "
" 183	9	23 10 11.22	3 11 13.91	" "
B. A. C. 8127	6	23 13 12.60	4 37 3.90	B. A. Cat., Weisse Cat., Santini Cat.
Weisse XXIII. 524	7.8	23 25 5.63	+6 18 52.18	Weisse Cat., Rümker Cat., Santini Cat.

FIDES.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㊲ — *		㊲'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1855, Nov. 22	8 26 54.5	7	Weisse XXIII. 1075	—0 24.84	— 6 14.23	23 52 12.79	+ 0 10 58.80
		7	" 1090	—0 58.90	— 4 50.35	23 52 12.79	0 10 57.93
23	8 28 36.5	7	" 1075	—0 5.37	— 3 4.98	23 52 32.26	0 14 8.00
		7	" 1090	—0 39.44	— 1 39.72	23 52 32.24	0 14 8.52
24	7 44 54.6	5	" 1075	+0 14.77	+ 0 8.64	23 52 52.39	0 17 21.58
		5	" 1090	—0 19.23	+ 1 32.71	23 52 52.45	0 17 20.91
26	7 11 6.7	6	" 1079	+1 1.00	+ 7 8.55	23 53 38 62	0 21 21.40
		6	" 1090	+0 26.94	+ 8 32.84	23 53 38.61	0 21 20.91
27	7 59 23.2	5	" 1075	+1 27.04	+11 0.17	23 54 4 65	0 28 12.97
		5	" 1090	+0 53.06	+12 21.78	23 54 4.72	0 28 12.83
29	6 51 42.0	10	" 1179	—2 23.66	— 8 2.50	23 55 0.11	0 36 1.71
30	7 5 39.8	8	" 1179	—1 53.05	— 3 46.08	23 55 30.72	0 40 21.40
Dec. 1	7 24 23.5	8	" 1179	—1 20.87	+ 0 39.61	23 56 2.88	0 44 47.01
5	7 25 15.1	12	" 1218	—1 3.23	+ 0 22.55	23 58 25.72	1 3 53.52
6	7 39 23.6	10	" 1218	—0 23.35	+ 5 30.63	23 59 5.60	1 9 1.14
7	7 37 24.6	7	" 1218	+0 17.38	+10 49.92	23 59 46.30	1 11 20.37
18	7 46 0.0	7	Weisse O. 112	+1 27.25	—12 35.25	0 8 45.49	2 21 11.06
26	8 3 20.7	7	" 312	—2 0.89	+17 11.56	0 16 51.24	3 18 46.91
30	8 10 56.6	10	" 337	+1 0.88	+ 1 33.59	0 21 19.83	3 50 8.57
1856, Jan. 4	8 46 49.6	5	" 496	—2 11.95	— 5 30.77	0 27 18.93	4 31 31.96
(1) 6	8 37 41.4	6	" 496	+0 17.54	+11 45.76	0 29 48.40	4 48 51.37
15	7 37 10.4	12	B. A. C. 216	+1 45.80	+11 46.80	0 41 42.06	6 9 1.14
16	7 7 39.7	6	" 216	+3 7.82	+20 56.58	0 43 4.07	6 18 10.88
		6	Weisse O. 742	+0 2.62	— 1 12.67	0 43 3.82	6 18 12.52
17	7 42 41.2	10	" 742	+1 29.21	+ 8 19.89	0 44 30.40	6 27 45.00
18	7 30 52.7	10	" 808	—0 26.21	+ 7 31.32	0 45 54.92	6 37 8.33
(2) 25	8 14 13.3	7	" 1013	—1 39.24	+11 10.28	0 56 14.49	7 41 43.22
29	8 3 42.4	6	" 1078	+1 25.93	—12 26.68	1 2 21.25	8 21 22.37
30	7 41 5.2	10	" 1078	+2 57.81	— 2 40.40	1 3 53.12	8 31 8.58
Feb. 1	7 47 50.5	10	" 113	—1 11.46	— 7 0 73	1 7 2.94	8 54 13.67
2	7 40 12.5	10	" 113	+0 23.61	+ 3 0.20	1 8 38.07	9 4 14 53
3	7 40 16.3	10	" 113	+1 59.93	+13 9.69	1 10 14.32	9 11 23.96
9	7 32 7.9	6	" 313	+0 59.10	+ 6 39.42	1 20 3.09	+10 15 36.60

(1) Jan. 6, Ex. Therm. 9. Intern. Therm. 26.

(2) Jan. 25, Ex. Therm. 3. Intern. Therm. 18.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㊲ — *		㊲'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1856, Feb. 12	8 9 28.4	6	Weisse O. 114	+0 32.71	—10 32.29	1 25 8.10	+10 46 41.21
17	7 22 3.8	5	" 539	+2 8.94	— 4 22.12	1 33 40.16	11 37 55.57
20	7 33 2.6	5	" 687	+1 9.33	— 1 52.16	1 38 56.37	12 9 10.73
21	7 34 56.5	7	" 716	+0 48.35	— 8 39.32	1 40 42.63	12 19 32.48
24	7 37 52.9	7	" 826	—0 5.10	—13 33.38	1 46 4.01	12 50 33.92
25	7 35 18.0	5	" 826	+1 42.93	— 3 12.87	1 47 52.03	13 0 53.20
Mar. 3	7 27 51.6	6	" 1047	+1 35.91	+14 31.92	2 0 42.49	14 12 40.09
5	7 28 7.9	10	B. A. C. 683	—0 44.09	— 3 8.13	2 4 27.36	14 33 2.44
7	7 21 33.0	5	Weisse II. 109	+0 9.86	—15 40.61	2 8 13.72	+14 53 17.76

These observations, up to the 27th of November and 7th of December, have been published in the *Astronomical Journal* and *Astronomische Nachrichten*. They have been since re-computed, and the stars' places corrected.

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*		Mag.	α	δ	Authority.
			h. m. s.	° ′ ″	
Weisse XXIII.	1075	9	23 52 50.31	+ 0 18 35.59	α Bond's Zones ; δ W. Mural, Yarnall.
"	1090	9	23 53 21.36	0 17 10.85	α Bond's Zones and Ast. Nach. ; δ W. Mural, Yarnall.
"	1179	8	23 57 36.47	0 45 30.15	α Weisse's Catalogue ; δ W. Mural, Yarnall.
"	1218	8	23 59 41.70	1 4 53.39	α " " " "
Weisse O.	112	9	0 7 31.08	2 35 9.12	Weisse's Catalogue.
"	312	7	0 19 5.01	3 2 57.98	Santini's Catalogue.
"	337	8	0 20 31.88	3 49 57.60	Weisse's Catalogue and Rümker's Catalogue.
"	496	8	0 29 43.84	4 38 27.58	" " " "
B. A. C.	216	7	0 40 9.32	5 58 35.51	Rümker's Catalogue and B. A. Catalogue.
Weisse O.	742	9	0 43 14.28	6 20 45.97	" " " Weisse's Catalogue.
"	808	9	0 46 34.21	6 30 57.63	" " " " "
"	1013	8	0 58 6.91	7 34 52.17	Weisse's Catalogue.
"	1078	9	1 1 8.57	8 38 7.12	
Weisse I.	113	8	1 8 27.69	9 2 32.23	α Santini's Catalogue ; δ W. Mural, Yarnall.
"	313	8.9	1 19 17.09	10 10 13.50	Weisse's Catalogue.
"	414	9	1 24 48.86	10 58 28.86	
"	539	8.9	1 31 44.77	11 43 31.92	
"	687	9	1 38 0.65	12 12 16.01	
"	716	9	1 40 7.90	12 29 24.48	
"	826	9	1 46 22.80	13 5 17.75	
"	1047	9	1 59 20.42	13 59 17.11	
B. A. C.	683	7	2 5 25.35	14 37 18.38	B. A. Catalogue.
Weisse II.	109	8	2 8 17.82	+15 10 5.21	Weisse's Catalogue.

LEDA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㊳ — *		㊳'s apparent	
				Δ α	Δ δ	α	δ
1856.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
March 3	8 7 2.2	2	B. Z. 281, 144	+1 3.16	+5 12.63	8 1 0.79	+16 54 58.11
5	8 10 49.5	4	" "	0 46.58	2 29.49	8 0 44.20	16 52 14.05
6	8 18 13.4	5	" "	+0 41.23	+1 2.43	7 59 38.83	+16 50 47.98

Adopted Mean Place, 1860.0, *of Comparison-Star.*

α	δ
h. m. s.	° ′ ″
8 0 10.14	+16 49 2.04

THIRTY-NINTH ASTEROID.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㊴ — *		㊴'s apparent	
				$\varDelta\alpha$	$\varDelta\delta$	α	δ
1856.	h. m. s.			m. s.	′ ″	h m. s.	° ′ ″
March 24	9 31 10.5	10	Weisse X. 914	—0 21.46	—6 35.79	10 50 20.23	+10 21 32.48
25	9 47 18.5	8	" 914	—0 58.89	—0 28.51	10 49 42.80	+10 27 39.79

Adopted Mean Place, 1860.0, *of* Weisse X. 914.

α	δ	Authority.
h. m. s.	° ′ ″	
10 50 52.73	+10 26 57.32	Rümker's Catalogue.

COMET 1855, III.

Date.	M T. Washington.	No. of Comp.	Comparison-Star.	☄ — *		☄'s apparent	
				$\varDelta\alpha$	$\varDelta\delta$	α	δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Dec. 26	6 35 26.3	3	Lalande 967	—10 30.58	—0 22.58	0 28 33.74	+1 57 49.13

Adopted Mean Place, 1860.0, *of Comparison-Star.*

α	δ
h. m. s.	° ′ ″
0 29 17.13	+1 59 34.00

ELEMENTS AND EPHEMERIS OF LÆTITIA.

By Mr. GEORGE RÜMKER.

[Communicated by Professor PETERS.]

Elements.

Computed from three normal places, Feb. 9.0 ; March 3.5 ; and March 26.5.

Epoch, 1856, April 0.0.

M	165° 25′ 48.8″	Mean Equinox, 1856.0.
π	0 39 44.5	
☊	157 23 40.2	
i	10 28 9.8	
φ	6 40 54.2	
Log a	0.442181	

Ephemeris for Mean Berlin Midnight.

1856.	㊴ α	㊴ δ	Log $\triangle$	1856.	㊴ α	㊴ δ	Log $\triangle$
	h. m. s.	° ′			h. m. s.	° ′	
March 29	10 47 29	+10 49.9	0.3380	April 5	10 44 7	+11 24.7	
30	46 57	10 55.3		6	43 43	29.0	0.3508
31	46 26	11 0.6		7	43 20	33.2	
April 1	45 56	5.7		8	42 58	37.2	
2	45 27	10.7	0.3441	9	42 37	41.1	
3	45 0	15.6		10	42 17	44.8	0.3580
4	10 44 33	+11 20.3		11	10 41 58	+11 48.4	

1856.	㊴ α	㊴ δ	Log △	1856.	㊴ α	㊴ δ	Log △
	h. m. s.	° ′			h. m. s.	° ′	
April 12	10 41 40	+11 51.9		April 24	10 39 56	+12 20.1	
13	41 24	55.1		25	39 56	42.4	
14	41 9	11 58.3	0.3655	26	39 57	22.6	0.3906
15	40 56	12 1.2		27	39 59	23.6	
16	40 45	3.9		28	40 2	24.5	
17	40 35	6.4		29	40 7	25.2	
18	40 26	8.7	0.3738	30	40 13	25.8	0.3994
19	40 18	11.0		May 1	40 20	26.2	
20	40 11	13.1		2	40 28	26.5	
21	40 5	15.1		3	40 38	26.7	
22	40 1	16.9	0.3821	4	10 40 49	+12 26.8	0.4082
23	10 39 58	+12 18.6					

FORTIETH ASTEROID.

A new Planet was discovered by Mr. Hermann Goldschmidt, at Paris, March 31st, its approximate place being

		α	δ
1856, March 31	$10^{h}\ 5^{m}$ Mean Time Paris.	$13^{h}\ 13^{m}\ 30^{s}$	—0° 2′

Subsequent observations have given the apparent positions: —

Date, 1856.	Mean Time.	Place.	㊵ α	㊵ δ
			h m. s.	° ′
April 1	Transit	Paris	13 12 32.86	+0 6.8
6	"	Altona	13 7 44.52	+0 34 46″.1
6	$10^{h}\ 23^{m}\ 39^{s}$	Hamburg	13 7 48.29	+0 34 21.0

Mr. Goldschmidt estimates the planet as of the 9.10 magnitude.

The Thirty-ninth Asteroid has received the name of *Lætitia*.

B. A. GOULD, Jr.

Cambridge, 1856, *April* 25.

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Elements and Ephemeris of Lætitia, by Mr. George Rümker.
Fortieth Asteroid.

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THE

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ON THE DETERMINATION OF THE GEOGRAPHICAL LONGITUDE FROM EQUAL ALTITUDES OF THE MOON AND A STAR.

By Dr. J. A. C. OUDEMANS,
OF LEYDEN.

When the government of the Netherlands decided, some five years ago, to establish a firm basis for the geography of the East Indian Archipelago, by means of astronomical observations instituted for the purpose, Professor Kaiser was requested by the Ministry of the Colonies to assign the methods most appropriate for use in this expedition, to give practical instruction to the engineer detailed for this service, during his stay in Leyden, and to make a proper selection of the instruments to be ordered. Of his labors in the first and last respect, he gave a report in a work published in 1851, under the title, *De sterrekundige plaatsbepaling in den Indischen Archipel en de maatregelen op gezag van Z. E. den Minister van Koloniën tot hare voorbereiding genomen, door F. Kaiser, Hoogleeraar te Leiden. Uitgegeven op last en voor rekening van het Departement van Koloniën.* Amsterdam. 1851. 8vo. pp. 160.

This dissertation consists of three parts, the first treating of the history and object of the projected astronomical expedition, the second of the scientific demands upon it, and the methods deserving preference in regions near the equator, and the third upon the instruments selected and provided for the astronomical determinations.

And while this memoir is of interest for every astronomer and geographer, there is for those who are to be occupied with geographical determinations in the vicinity of the equator no practical treatise in which may be found so complete and critical a survey of all that has been written concerning the determination of longitudes and latitudes. And just as everything emanating from Professor Kaiser manifests great originality, so too here are peculiar and original ideas, especially in the second chapter, upon different geographical methods.

The determination of longitudes by means of lunar altitudes, although recommended now and then in former times, has in more recent years been rejected by many astronomers as inaccurate. Even Schumacher, in cursorily noticing Rümker's *Längen-Bestimmung durch den Mond*, especially commended the omission of the method by lunar altitudes.* "It is again most clearly evident," says Professor Kaiser (page 71), "from this remark of Schumacher, how little astronomers in general occupied themselves with astronomical determinations of position in very low latitudes."

Professor Kaiser, in treating (pp. 63 and ff.) of the known methods of determining longitude by observations of the moon and moon-culminating stars, first makes the remark that a travelling astronomer can very easily multiply his determinations in a single night, by observing transits of the moon and neighboring stars across the same vertical. The application of the simplest theorems of the Calculus of Probabilities shows us, as the author remarks, still further, that the same precision may be obtained in much shorter time, if, instead of using the ordinary moon-culminating stars of the *Nautical Almanac* (for which an hour and a half is frequently requisite), we make repeated observations of transits of the moon and a star through the same vertical. That star is selected which is the nearest to the moon, either preceding or following. This method has the advantage over the long known and not unfrequently used method of determining the longitude by azimuths of the moon, that it is entirely independent of any reading of a horizontal circle. A transit-instrument with only approximate horizontal graduation is quite sufficient. "Mr. De Lange during his stay in Leyden made use of this method, and found that, in a latitude as high as that of Leyden, it offers no difficulty, while it might be readily foreseen that it would be attended with great advantages." This remark applies especially to those cases when the transit of the moon is observed on the same day at more than one of the larger observatories.*

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* The remark of Professor Schumacher (*Astr. Nachr.* XXIX. 111) evidently referred to the general method of determining longitudes by direct measurement of the moon's zenith-distance, and seems by no means to apply either to transits of the moon and star across a vertical, or to this elegant method of equal altitudes. — G.

In low latitudes, however, this method will frequently prove utterly inadequate, and only observations of a transit of the moon, and of one or more moon-culminating stars, will afford sufficient precision; the change of azimuth of moon and star will in many cases take place so slowly, that observation of transits of the moon and stars over the same extra-meridian vertical will either afford extremely inaccurate results, or else become absolutely impossible. In just these cases the method named in the title of this paper becomes the most desirable, and of this the observations of Messrs. S. H. and G. A. De Lange † offer the most convincing proof.

Preparatory to making use of this method, the geographer computes approximately the times at which the moon and star attain the same altitude, — and, moreover, the azimuth which each of them has at the moment; he observes the time when the first object reaches this altitude, and, without unclamping the vertical circle, brings the telescope into the proper azimuth for the transit of the second object. The level of the vernier-circle of the microscope frame is read off at each transit, by which means the slight difference which may exist between the altitudes at which the two objects are observed becomes accurately known. This difference can arise partly from a want of absolute verticality in the vertical axis, and partly from its change of position during the interval between the two observations. Immediately after the observation of the second transit, the telescope is set for another altitude, and the observation repeated. It will be easy so to arrange the preliminary computation, that as little time as possible shall be lost between the successive settings. In this manner the observations can be several times repeated on the same day, and the precision of each observed transit may be still further increased by providing the telescope with a diaphragm of horizontal threads.

It is also manifest that this method is capable of furnishing very trustworthy results, inasmuch as there is need neither of reading off any circle, nor of computing the refraction, and only those times are employed at which moon and star cross the same almucantar, — times which may be observed with a precision equal to that of the times of transit across the meridian.

The question now arises, in what way the longitude may be most advantageously deduced from observations of this kind. As long ago as 1850, when Mr. S. H. De Lange was in Leyden, I was occupied with this problem. It would naturally be the simplest, if from the difference of the observed times we could also in some convenient way compute the difference of the right ascensions without the employment of large logarithm-tables; but my endeavors to solve the problem in this spirit were unsuccessful, and I believe that, if a general solution is required which shall be capable of convenient application for all declinations of the moon and the moon-culminating star which may present themselves, it will be impossible to escape the computation of two zenith-distances by means of logarithms to six or seven places. But after all, what harm is this? The six-figure logarithm-tables of Bremiker are so convenient for use, that at the most only half the time is needed which is requisite for computation with seven-figure logarithms. Yet they afford a precision quite sufficient for this kind of computation, inasmuch as the uncertainty of one unit in the last decimal place of a log. tang. corresponds, in the most unfavorable case, to an uncertainty of only a quarter of a second in the arc. Now only times are observed, and in those cases in which the proposed method may be applied with advantage, the altitude of the moon or star changes by about $15''$ in every second of time. The uncertainty attending the use of the six-figure logarithms is accordingly, when reduced to time, never greater than $1'''$, and the probable error of the result is therefore increased by almost nothing at all.

There is a memoir of Lindenau, *Ueber Längenbestimmungen durch Mondshöhen*, in the *Monatliche Correspondenz* for December, 1805. The author assumes that several altitudes of the moon's limb have been measured, corrected for refraction and parallax, and reduced to the center of the moon. Then he shows, in the first place, how to reduce the several observations to one moment, and next how to deduce the hour-angle, and the right ascension, from the altitude thus obtained, and the moon's declination taken from the almanac. After this, that time of that meridian for which the almanac has been computed is found, which belongs to the right-ascension, and this furnishes the difference of longitude. And, still further, Lindenau gives the differential coefficients by which we may compute the influence exerted by an error in the moon's declination, the measured altitude, or the assumed value of the latitude upon the computed hour-angle, and finally illustrates the method by an example.

I have preferred to compute the two zenith-distances of the moon and of the star, from an assumed longitude; and, after correcting the former for parallax and semidiameter, to compare the difference of the two zenith-distances with the small difference indicated by the fixed level; — deducing, finally, the correction of the assumed longitude from the inequality of these two differences. By this we obtain the advantages, — 1st, that *the same* computation is to be made both for moon and star; 2dly, that, instead of seeking the time which corresponds to a given right-ascension, we have the much more convenient and simple process of taking from the ephemeris the moon's place for a given time; 3dly, the final formula, by which the relation between the above-mentioned differences and the corrections of the several elements required for the computation becomes very simple.

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* And also if we may assume that the lunar tables will, as those of Hansen promise to do, give the moon's place more accurately than it would be deduced from a single meridian observation. — J. A. C. O.

† The geographical engineer referred to above, as detailed for the expedition, was Mr. S. H. De Lange, to whom his brother, Mr. G. A. De Lange, was subsequently added, as assistant. The former was attacked in the year 1854, at Batavia, by disease, and died in May of that year, on board the ship in which he had taken passage for the restoration of his health.

The Messrs. De Lange computed* in this way the two zenith-distances, that of the moon and of the star; and in order to find the correction of their assumed longitude, the computation for the moon was repeated with a longitude differing by ten seconds of time. But it will be perceived, from what follows, that this repetition is entirely superfluous; and that those very quantities appear in the computation of the reduction to the middle thread, which are requisite for calculating the desired differential coefficients.

Finally, it appears to me exceedingly desirable that the computer should append to the result all those terms which show the magnitude of the changes which will be produced upon the longitude by slight corrections of the elements necessary for the computation; — and from the following solution it will be seen that the computation of these terms is far from being too tedious.

Let t and T be the chronometer-times at which the star attains the zenith-distance z, and the moon's limb the zenith-distance $z + i$, in which i is the difference of the readings of the fixed level. Furthermore, put

the chronometer correction $= \Theta$
" right ascension (in time) of the star $= \alpha$, of the moon $= A$
" north-polar distance " " $= \pi$, " " $= \Pi$
" azimuth (from S. toward W.) " $= \omega$, " " $= \Omega$
" parallactic angle " $= \nu$, " " $= N$
" approximate co-latitude $= \psi$, and its correction $= \delta\psi$
" " longitude E. from Greenwich, in time $= L$
and the correction to be applied to this $= \delta L$

Then A and Π are to be taken from the *Nautical Almanac* for the Greenwich time $T + \Theta + L$. And so, also, are to be taken from the *Almanac*

the moon's change of right-ascension in one second of sidereal time, $= \Delta A$
the moon's change of polar distance in one second of sidereal time, $= \Delta\Pi$
the moon's equatorial horizontal parallax, $= H$
" " geocentric semidiameter, $= R$

and furthermore, let

the parallax in altitude of the observed limb be P
" moon's geocentric zenith-distance " Z
" " apparent " " " Z'
" star's true zenith-distance (uncorrected for refraction) " z
" star's apparent zenith-distance (uncorrected for refraction) z'

There are many systems of formulas which may be used for the computation of the parallactic triangle. The following one affords the advantage, that all the angles and arcs are found by means of their tangents, and consequently permit of rigorous determination for all possible cases.

$$s = t + \Theta - \alpha \qquad\qquad S = T + \Theta - A$$

$$\left.\begin{aligned}\tan b &= \tan\psi\cos s\\ \tan\gamma &= \sin b\tan s\end{aligned}\right\} \qquad \left.\begin{aligned}\tan B &= \tan\psi\cos S\\ \tan\Gamma &= \sin B\tan S\end{aligned}\right\}$$

$$\left\{\begin{aligned}\tan e &= \frac{\tan(\pi - b)}{\sin\gamma}\\ \tan z &= \frac{\tan\gamma}{\cos e}\end{aligned}\right. \qquad \left.\begin{aligned}\tan E &= \frac{\tan(\Pi - B)}{\sin\Gamma}\\ \tan Z &= \frac{\tan\Gamma}{\cos E}\end{aligned}\right\}\text{with six decimals.}$$

$$\left\{\begin{aligned}\tan c &= \frac{\operatorname{cotan} s}{\cos\psi}\\ \tan\nu &= \frac{\operatorname{cotan} e}{\cos z} = \frac{\tan\gamma}{\sin(\pi - b)}\end{aligned}\right. \quad \left.\begin{aligned}\tan C &= \frac{\operatorname{cotan} S}{\cos\psi}\\ \tan N &= \frac{\operatorname{cotan} E}{\cos Z} = \frac{\tan\Gamma}{\sin(\Pi - B)}\end{aligned}\right\}$$

[with four decimals.

$$\omega = 180^\circ - c - e \qquad\qquad \Omega = 180^\circ - C - E$$
$$z' = z - \text{Refraction}, \qquad Z' = Z + P \mp R - \text{Refraction},$$

in which the upper sign holds for the upper limb, and *vice versa*.

The reduction of the observed zenith-distance Z for semidiameter and parallax is $= \pm$ the apparent semidiameter R', $+$ the parallax for the center (P). But a diagram will show that the error committed by using $\pm R + P$ instead of $\pm R' + (P)$ is equal to

$$R\,(1 - \cos P) = \tfrac{1}{2}\,R\sin^2 P,$$

i. e. of an order higher than we need consider, and amounting at the most to 0.″15.

The parallax P is to be computed from the formula

$$\sin P = \varrho\sin H\sin Z_1,$$

in which $Z_1 = z + i - (\psi' - \psi)\cos\Omega$, and ϱ denotes the radius of the terrestrial spheroid at the place of observation, ψ' denoting the geocentric "co-latitude."

If, now, the geographical longitude and all the other elements of computation are accurately assumed, we must have $Z' = z' + i$, or, inasmuch as the two refractions hold for equal apparent zenith-distances, and are therefore equal,

$$Z + P \mp R = z + i.$$

But supposing that unequal values be found for the two terms, and in fact

$$Z + P \mp R = z + i + \zeta,$$

the question then arises, how ζ depends upon the several corrections which the quantities occurring in the computation require.

In the parallactic triangle, pole, zenith, star,

$$\delta z = -\cos\omega\,.\,\delta\psi + 15\sin\pi\sin\nu\,.\,\delta s + \cos\nu\,.\,\delta\pi.$$

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* *Astronomische Waarnemingen gedaan ter bepaling der geografische ligging van Batavia, door* S. H. De Lange *en* G. A. De Lange, *Geografische Ingenieurs voor Nederlandsch-Indië.* Probably a reprint from the *Tydschrift der natuurkundige Vereeniging in Neêrl-Indië.* 1854.

And, in like manner, in the parallactic triangle, pole, zenith, moon,

$$\delta Z = -\cos \Omega \,.\, \delta \psi + 15 \sin \Pi \sin N \,.\, \delta S + \cos N \,.\, \Delta \Pi.$$

But since A and Π are taken from the *Nautical Almanac*, with the time $T + \Theta + L$, δA consists of two parts: 1st, the actual correction of the ephemeris; and 2dly, $(\delta T + \delta \Theta + \delta L)\, \Delta A$, where ΔA denotes the change of the moon's right ascension in one second of sidereal time. I therefore keep T and Θ separated, in order that the final formula may distinctly show what effect is produced upon the result by an error in the observed transit of the moon or star, and what by an error in the determination of time. The same remark applies to $\delta \Pi$, and therefore

$$\delta z = -\cos \omega \,.\, \delta \psi + 15 \sin \pi \sin \nu \,(\delta t + \delta \Theta - \delta \alpha) + \cos \nu \,\delta \pi$$
$$\delta Z = -\cos \Omega \,.\, \delta \psi + 15 \sin \Pi \sin N \,[\delta T + \delta \Theta - \delta A - \Delta A\,(\delta T + \delta \Theta + \delta L)] + \cos N\,[\delta \Pi + \Delta \Pi\,(\delta T + \delta \Theta + \delta L)].$$

We have, moreover, with sufficient precision

$$\delta P = \sin Z_1 \,\delta H + H \cos Z_1 \sin 1'' \,\delta Z_1 = \sin Z_1 \,\delta H + H \cos Z_1 \sin 1'' \,\delta z.$$

If, now, $\alpha + \delta \alpha$, $\pi + \delta \pi$, $A + \delta A$, &c., are really the correct values of the elements of computation, we must have

$$Z + P \mp R + \delta Z + \delta P \mp \delta R = z + \delta z + i.$$

But since
$$Z + P \mp R = z + i + \zeta,$$
$$\zeta = -\delta Z + \delta z - \delta P \pm \delta R = -\delta Z + (1 - H \cos Z_1 \sin 1'')\, \delta z - \sin Z_1 \,\delta H \pm \delta R.$$

Putting, for brevity's sake, $1 - H \cos Z_1 \sin 1'' = \mu$, our desired equation becomes

$$\begin{aligned}
\zeta = {} & (\cos \Omega - \mu \cos \omega)\, \delta \psi + (15 \sin \pi \sin N \,.\, \Delta A - \cos N \,\Delta \Pi) \,.\, \delta L \\
& - [15 \sin \Pi \sin N\,(1 - \Delta A) + \cos N\, \Delta \Pi] \,.\, \delta T + 15 \mu \sin \pi \sin \nu \,.\, \delta t \\
\text{(A)} \qquad & + [15 \mu \sin \pi \sin \nu - 15 \sin \Pi \sin N\,(1 - \Delta A) - \cos N\, \Delta \Pi] \,.\, \delta \Theta \\
& + 15 \sin \Pi \sin N \,.\, \delta A - 15 \mu \sin \pi \sin \nu \,.\, \delta \alpha - \cos N \,.\, \delta \Pi + \mu \cos \nu \,.\, \delta \pi - \sin Z_1 \,\delta H \pm \delta R.
\end{aligned}$$

Remarks. 1. In this final formula precisely those terms which refer to the star are affected with the factor μ, dependent upon the lunar parallax. This arises from the circumstance that we have calculated the moon's parallax by means of the computed apparent zenith-distance z of the star. In practice, this is the easiest method, and any error which may exist in this computed z is properly allowed for, in the final formula.

But, theoretically, it is a more obvious method to deduce the moon's parallax from the computed geocentric zenith-distance of the moon. This gives

$$Z_1 = Z - (\psi' - \psi) \cos \Omega$$
$$\frac{R}{R'} \sin (P) = \varrho \sin H \sin Z_1$$
$$\frac{R}{R'} \cos (P) = 1 - \varrho \sin H \cos Z_1.$$

And the apparent zenith-distance of the moon's limb,

$$Z = Z + (P) \mp R' - \text{Refraction}.$$

Now, putting

$$1 + H \cos Z_1 \sin 1'' = \frac{1}{\mu},$$

the final formula will, in this case, become,

$$\begin{aligned}
\zeta = {} & \left(\frac{1}{\mu} \cos \Omega - \cos \omega\right) \delta \psi + \left(\frac{15}{\mu} \sin \Pi \sin N \,.\, \Delta A - \frac{1}{\mu} \cos N \,.\, \Delta \Pi\right) \delta L \\
& - \left[\frac{15}{\mu} \sin \Pi \sin N\,(1 - \Delta A) + \frac{1}{\mu} \cos N \,.\, \Delta \Pi\right] \delta T + 15 \sin \pi \sin \nu \,.\, \delta t \\
& + \left[15 \sin \pi \sin \nu - \frac{15}{\mu} \sin \Pi \sin N\,(1 - \Delta A) - \frac{1}{\mu} \cos N\, \Delta \Pi\right] .\, \delta \Theta \\
& + \frac{15}{\mu} \sin \Pi \sin N \,.\, \delta A - 15 \sin \pi \sin \nu \,.\, \delta \alpha - \frac{1}{\mu} \cos N \,.\, \delta \Pi + \cos \nu \,\delta \pi - \sin Z \,.\, \delta H \pm \delta R.
\end{aligned}$$

2. From this formula may be immediately deduced the reduction to the middle thread. — If, namely, the interval from a side thread to the middle one be $= f^{s} = 15 f'$, the reduction for the star will be

$$= \frac{f^{s}}{\sin \pi \sin \nu} = \frac{f^{s}}{\sin \omega \sin \psi},$$

and for the moon,

$$= \frac{\mu f^{s}}{\sin \Pi \sin N\,(1 - \Delta A) + \frac{1}{15} \cos N \,.\, \Delta \Pi}.$$

The refraction is here left out of consideration. This tends to increase the time needed by the star for traversing the thread-intervals; but if those threads only are used which are symmetrically situated with respect to the middle one, this effect is eliminated, if the observation be not made much too near the horizon. But if the threads across which the transits were observed are not symmetrical about the middle thread, the above times must be multiplied by

$$1 + \frac{k \sin 1''}{\cos^2 z},$$

in which k is to be taken from the following table, given by Bessel for a similar purpose in his memoir, "*Ueber den Einfluss der Strahlenbrechung auf Mikrometer beobachtungen.*" *Astr. Nachr.* No. 69.

Table for Log. k.

Arg.: Half-sum of the true zenith-distances.

°	"	°	′	"	°	′	"	°	′	"
0	1.761	75	0	1.737	83	0	1.666	86	30	1.496
45	1.759	80	0	1.710	83	30	1.653	87	0	1.439
50	1.758	80	30	1.701	84	0	1.638	87	30	1.364
55	1.757	81	0	1.699	84	30	1.620	88	0	1.258
60	1.756	81	30	1.693	85	0	1.600			
65	1.753	82	0	1.685	85	30	1.573			
70	1.748	82	30	1.676	86	0	1.539			

For $z = 70°$, and $f = 40^{s}$, the correction amounts to nearly $0^{s.}.1$, and therefore cannot in such a case be neglected.

3. It will only in rare cases be necessary to compute the reduction to the middle thread. Provided that both the moon and the star be observed on the *same* threads, it will be sufficient in almost every instance to take the arithmetical mean of the computed times.

If, for example, the moon were to be observed on all the threads I. to V., but the star only on the threads II. to V., I would also exclude the moon's transit across the thread I., taking the arithmetical mean of the other four transits for the moon as well as for the star, and through the computation with this. The means will then refer, not to the middle thread, but to another horizontal line in the field of the telescope; but this evidently does no harm whatever. A slight advantage is thus sacrificed, but, on the other hand, are gained both time and the other advantage of being independent of the determination of the thread-intervals.

We will select for an example some observations made by Mr. De Lange on the 11th of October, 1853, at Batavia. We have

the assumed "co-latitude" of the place of
observation, $\psi = 96°\ 9'\ 57''.0$
the assumed East longitude from Greenwich, $L = 7^{h.}\ 7^{m.}\ 37^{s.}.0$
according to Bessel's formulas, $\log \varrho = 9.999987$
and $\psi' = 96°\ 7'\ 10''.0$

Among others the following times were noted at which the moon's lower limb and 36 *Capricorni* attained nearly the same altitude:

$$T = 0^{h.}\ 38^{m.}\ 8^{s.}.62 \qquad \text{and} \qquad t = 0^{h.}\ 49^{m.}\ 53^{s.}.77.$$

The chronometer correction $\Theta = +\,1^{m.}\ 3^{s.}.32$, and the difference of altitude as indicated by the level was $i = +\,2''.0$.

From the *Nautical Almanac* we find

$$\alpha = 21^{h.}\ 20^{m.}\ 22^{s.}.45 \qquad A = 21^{h.}\ 12^{m.}\ 5^{s.}.15$$
$$\pi = 112°\ 26'\ 30''.5 \qquad \Pi = 110°\ 55'\ 8''.9$$

Motion of the moon in an hour of mean time,

$$+\,139^{s.}.69 \text{ in } \alpha; \quad -\,519''.8 \text{ in N. P. D.}$$

Therefore in $1^{s.}$ sidereal

$$\Delta A = \frac{139^{s.}.69}{3610} = +\,0^{s.}.0387,$$

$$\Delta \Pi = -\frac{519''.8}{3610} = -\,0''.1440.$$

Furthermore,

$$H = 57'\ 51''.4, \qquad \text{and} \qquad R = 15'\ 47''.8.$$

The computation then gives:

$$\begin{aligned} s &= 52°\ 38'\ 39''.6 & S &= 51°\ 46'\ 37''.2 \\ z &= 53\ \ 13\ \ 57.5 & Z &= 52\ \ 11\ \ 49.75 \\ \nu &= 80\ \ 35 & N &= 81\ \ 19 \\ \omega &= 66\ \ 31 & \Omega &= 68\ \ 11.5 \end{aligned}$$

For computing the parallax,

$$(\psi' - \psi) \cos \Omega = -\,51''.5$$
$$Z_1 = 53°\ 14'\ 54'',$$

and therefore

$$P = 46'\ 21''.3;$$

we have, then,

$$\begin{aligned} Z + P + R &= 53°\ 13'\ 58''.85 \\ z + i &= 53\ \ 13\ \ 59.5 \\ \zeta &= \qquad -0.65 \end{aligned}$$

The computation of the final formula now presents no difficulty. We find $\log \mu = 9.9955$, and

$$\begin{aligned} \zeta = &-[8.3575]\,\delta\psi + [9.7467]\,\delta L \\ &-[1.1237]\,\delta T + [1.1315]\,\delta t + [9.3819]\,\delta\Theta \\ &+[1.1415]\,\delta A - [1.1315]\,\delta\alpha \\ &-[9.1855]\,\delta\Pi + [9.2093]\,\delta\pi \\ &-[9.9037]\,\delta H - \delta R \end{aligned}$$

where, instead of the coefficients, are put their logarithms as given by computation. Separating δL in the first term, we find, after substituting the value of ζ, and passing to the numbers themselves,

$$\begin{aligned} \delta L = -\,1^{s.}.16 + 0.041\,\delta\psi &+ 23.82\ \delta T - 24.25\,\delta t - 0.13\,\delta\Theta \\ &- 24.82\ \delta A + 24.25\,\delta\alpha \\ &+ 0.275\,\delta\Pi - 0.29\,\delta\pi \\ &+ 1.435\,\delta H + 1.79\,\delta R \end{aligned}$$

Leyden, October, 1855.

The zenith-telescope, so extensively, and, indeed, almost exclusively, used in our American latitude-determinations, although not yet employed for this purpose in other countries, so far as I am aware, offers, in the manner of its use for determining the place of the zenith from slight differences of altitude in stars crossing the meridian north and south, a striking analogy to the method here described and investigated by Dr. Oudemans. This instrument is, in fact, simply a universalinstrument, provided with a delicate micrometer and level, and with stops to facilitate a rapid setting to the meridian, or to any other desired azimuth; and in the form now constructed by Mr. Wurdemann, of Washington, is especially adapted for convenient use. When furnished with a diaphragm of vertical threads, it affords a ready means of determining time with very considerable accuracy; and the addition of two horizontal threads to the movable diaphragm will in many cases aid its employment for the measurement of latitude, and enable the geographer traveling in tropical regions to avail himself of the excellent method of Professor Kaiser for determining longitude. In short, for the torrid zone, the zenith-telescope, as now employed by the United States Coast-Survey, needs but the addition of a few spider-lines to furnish the time, the latitude, and the longitude, in a single night, with all desired precision, and requires only the addition of a chronometer, a star-catalogue, and a *Nautical Almanac*, to render the equipment of a geographical observatory complete. It thus becomes to the practical geographer all that the sextant is to the navigator; and, indeed, somewhat more, as furnishing a higher degree of precision with a relatively less expenditure of labor.

G.

ON THE OBSERVATION OF THE ASTEROIDS.

In No. 54 of this Journal, the Editor called attention to the circumstance that the rapid increase in the number of known asteroids renders their regular observation and computation a work of such magnitude and extent that more than a proportionate share of the energies and efforts of astronomers is required for attaining a proper knowledge of their several orbits. And, as is proved by the experience of every week, the want of some appropriate scheme or system of observation is greatly increasing the labors of observers and computers, two or more of whom are constantly found directing their attention to the same asteroid, to the exclusion of some other one of the small planets, which remains almost unobserved, and its orbit only approximately computed.

To obviate this prodigality of labor, on the one hand, and on the other to render the labor more productive, I had suggested, in 1851, the desirableness of some arrangement among astronomers by which the work might be more efficiently executed with less consumption of time and labor. These ends might be readily attained by an apportionment among observatories of the labor of observation, and among computers of the duty of determining the orbits and providing ephemerides; and the apportionment might easily be made by an announcement on the part of individual astronomers of their willingness to undertake and hold themselves responsible for determinations of place or orbit of particular members of the asteroid group. To this end the Superintendents of the Washington Observatory and the American Ephemeris authorized the announcement, in February, 1853, that they held themselves ready to assume their respective shares of the work thus devolving upon them.

The proposition has appeared, with very few exceptions, to receive general approbation; but immediate steps have not been taken to carry it into effect, with any degree of completeness. The demonstrations of Hansen, Encke, and Brünnow, of the perfect feasibility of tabulating the orbits of the small planets, promises gradually to relieve, in a great measure, the pressure upon computers; but, in the mean time, the number of asteroids has increased to forty, with an average annual addition of about four to this number, — doubling the demands upon observers.

Lieutenant Maury, of the United States Naval Observatory at Washington, has written to call attention again to the importance of a division of labor on the part of observatories. In a letter dated 1856, May 2, he says: —

"I propose to pledge the Washington Observatory for the requisite observations with the Equatorial, upon eight of these new planets; hoping that other astronomers will approve of the suggestion, and portion out the remainder according to their convenience. With this hope Mr. Ferguson has been instructed to undertake a regular series of observations with the large equatorial of this Observatory upon the eight following, viz.: —

Egeria,	*Irene,*	*Phocea,*	*Fides,*
Psyche,	*Melpomene,*	*Circe,*	*Thetis.*

Astronomers who are willing to take part in such an arrangement are respectfully invited to make known, either through the columns of your Journal, or those of the *Astronomische Nachrichten*, the names of the asteroids each will undertake. In the mean time, however, observations will be made here upon as many as practicable of the other members of this family, during the first and second oppositions succeeding discovery."

It seems but reasonable to anticipate that other American observatories, which will probably be in full operation within a year, will be cheerfully ready to assume the observation of eight more asteroids. Twenty-four of those now known, together with such as may be discovered within the next year or two, will then remain; and the hope that European astronomers may be disposed to assume the labor of regular observation of these seems not unwarrantable.

G.

Cambridge, 1856, *May* 10.

EPHEMERIS OF CERES FOR 1857.

By ERNEST SCHUBERT.

[Communicated by Commander C. H. Davis, Superintendent American Ephemeris.]

Mean Washington Noon.

1857.		① α	① δ	Log Δ	Log r	1857.		① α	① δ	Log Δ	Log r
		h. m.	° ′					h. m.	° ′		
Jan.	0	10 34.6	+21 52.0	0.26348	0.40871	July	9	11 11.9	+14 50.9	0.47701	0.41272
	10	34.7	22 59.1	0.24059	0.40839		19	26.2	12 57.4	0.49164	0.41347
	20	31.9	24 18.5	0.22135	0.40814		29	40.8	11 2.0	0.50481	0.41427
	30	26.3	25 43.5	0.20737	0.40795	Aug.	8	11 55.7	9 5.0	0.51653	0.41510
Feb.	9	18.7	27 4.9	0.19998	0.40783		18	12 10.9	7 7.1	0.52681	0.41598
	19	9.7	28 12.8	0.19990	0.40775		28	26.3	5 9.2	0.53572	0.41690
March	1	10 0.9	28 59.8	0.20709	0.40773	Sept.	7	41.9	3 11.9	0.54319	0.41786
	11	9 53.3	29 21.7	0.22062	0.40778		17	12 57.7	+ 1 15.8	0.54927	0.41885
	21	47.9	29 19.1	0.23911	0.40788		27	13 13.7	− 0 38.2	0.55392	0.41987
	31	45.3	28 54.5	0.26104	0.40804	Oct.	7	29.9	2 29.3	0.55714	0.42092
April	10	45.5	28 11.8	0.28497	0.40826		17	13 46.1	4 17.0	0.55894	0.42201
	20	48.5	27 11.6	0.30973	0.40854		27	14 2.5	6 0.4	0.55928	0.42312
	30	9 53.8	26 5.7	0.33450	0.40887	Nov.	6	19.0	7 39.0	0.55813	0.42425
May	10	10 1.2	24 47.6	0.35865	0.40926		16	35.6	9 11.9	0.55547	0.42510
	20	10.3	23 21.7	0.38179	0.40971		26	14 52.1	10 38.7	0.55125	0.42658
	30	20.9	21 49.3	0.40372	0.41021	Dec.	6	15 8.6	11 59.0	0.54546	0.42778
June	9	32.5	20 11.3	0.42424	0.41076		16	25.0	13 12.2	0.53806	0.42899
	19	45.0	18 28.4	0.44331	0.41137		26	41.1	14 18.0	0.52901	0.43021
	29	10 58.2	+16 41.4	0.46092	0.41202		36	15 56.9	−15 16.6	0.51830	0.43143

EPHEMERIS FOR THE OPPOSITION.

Mean Washington Midnight.

1857.		① α	① δ	Log Δ	Log r	1857.		① α	① δ	Log Δ	Log r
		h. m. s.	° ′ ″					h. m. s.	° ′ ″		
Jan.	0	10 31 51.46	+21 53 38.4	0.262395	0.408683	Jan.	23	10 30 30.17	+24 46 32.0	0.215857	
	1	34 59.10	21 59 44.3	0.259993			24	29 58.45	24 55 3.5	0.214390	0.408018
	2	35 5.05	22 5 59.8	0.257616	617		25	29 25.16	25 3 36.2	0.212984	
	3	35 9.30	22 12 24.6	0.255264			26	28 50.36	25 12 9.3	0.211639	0.408011
	4	35 11.84	22 18 58.5	0.252939	554		27	28 14.09	25 20 42.3	0.210356	
	5	35 12.65	22 25 41.4	0.250643			28	27 36.39	25 29 14.6	0.209136	0.407976
	6	35 11.72	22 32 33.2	0.248376	493		29	26 57.30	25 37 45.6	0.207981	
	7	35 9.06	22 39 33.3	0.246140			30	26 16.88	25 46 14.6	0.206892	943
	8	35 4.65	22 46 41.7	0.243937	435		31	25 35.17	25 54 41.1	0.205870	
	9	34 58.49	22 53 57.9	0.241768		Feb.	1	24 52.22	26 3 4.5	0.204916	912
	10	34 50.57	23 1 21.8	0.239634	379		2	24 8.08	26 11 24.2	0.204031	
	11	34 40.90	23 8 53.0	0.237538			3	23 22.79	26 19 39.5	0.203217	884
	12	34 29.49	23 16 31.4	0.235480	325		4	22 36.43	26 27 49.9	0.202473	
	13	34 16.34	23 24 16.6	0.233462			5	21 49.05	26 35 54.9	0.201800	858
	14	34 1.44	23 32 8.2	0.231485	273		6	21 0.71	26 43 53.9	0.201199	
	15	33 44.81	23 40 5.8	0.229552			7	20 11.47	26 51 46.2	0.200670	834
	16	33 26.43	23 48 9.1	0.227664	223		8	19 21.11	26 59 31.4	0.200213	
	17	33 6.31	23 56 17.5	0.225821			9	18 30.58	27 7 8.7	0.199830	812
	18	32 44.47	24 4 30.8	0.224032	176		10	17 39.06	27 14 37.6	0.199520	
	19	32 20.93	24 12 48.4	0.222290			11	16 46.91	27 21 57.7	0.199285	793
	20	31 55.71	24 21 9.8	0.220600	131		12	15 51.20	27 29 8.4	0.199124	
	21	31 28.82	24 29 34.6	0.218964			☍ 13	15 0.99	27 36 9.2	0.199037	0.407776
	22	10 31 0.30	+24 38 2.2	0.217382	0.408088		14	10 14 7.35	+27 42 59.7	0.199025	

☍ 1857, February 13, 13h. 48m. 28s.8, Mean Time Washington. Intensity of light = 1.470.

1857.		① α			① δ			Log △	Log r
		h.	m.	s.	°	′	″		
Feb.	15	10	13	13.36	+27	49	39.3	0.199088	0.407762
	16		12	19.10	27	56	7.7	0.199224	
	17		11	24.65	28	2	24.3	0.199435	750
	18		10	30.08	28	8	28.7	0.199719	
	19		9	35.49	28	14	20.5	0.200078	741
	20		8	40.94	28	19	59.3	0.200509	
	21		7	46.53	28	25	24.7	0.201013	734
	22		6	52.34	28	30	36.6	0.201589	
	23		5	58.46	28	35	34.4	0.202237	729
	24		5	4.94	28	40	17.5	0.202955	
	25		4	11.87	28	44	46.2	0.203742	727
	26		3	19.31	28	49	0.4	0.204597	
	27		2	27.35	28	52	59.7	0.205519	727
	28		1	36.07	28	56	44.1	0.206507	
March	1	10	0	45.54	29	0	13.3	0.207560	729
	2	9	59	55.84	29	3	27.2	0.208676	
	3		59	7.03	29	6	25.8	0.209854	733
	4		58	19.16	29	9	9.1	0.211093	
	5		57	32.30	29	11	37.0	0.212391	739
	6		56	46.51	29	13	49.5	0.213748	
	7		56	1.85	29	15	46.8	0.215161	749
	8		55	18.35	29	17	28.9	0.216629	
	9		54	36.08	29	18	55.9	0.218150	0.407761
	10	9	53	55.08	+29	20	7.9	0.219722	
March	11	9	53	15.40	+29	21	5.0	0.221345	0.407775
	12	9	52	37.07	29	21	47.3	0.223017	
	13	9	52	0.15	29	22	14.9	0.224736	791
	14	9	51	24.67	29	22	27.9	0.226500	
	15	9	50	50.66	29	22	26.4	0.228309	810
	16	9	50	18.15	29	22	10.7	0.230161	
	17	9	19	47.19	29	21	40.8	0.232055	831
	18	9	49	17.80	29	20	56.9	0.233989	
	19	9	48	50.02	29	19	59.2	0.235962	855
	20	9	48	23.85	29	18	48.0	0.237971	
	21	9	47	59.33	29	17	23.5	0.240016	881
	22	9	47	36.47	29	15	46.0	0.242094	
	23	9	47	15.29	29	13	55.6	0.244203	909
	24	9	46	55.82	29	11	52.5	0.246343	
	25	9	46	38.07	29	9	36.8	0.248513	939
	26	9	46	22.06	29	7	8.7	0.250711	
	27	9	46	7.80	29	4	28.6	0.252935	0.407972
	28	9	45	55.29	29	1	36.7	0.255184	
	29	9	15	44.53	28	58	33.2	0.257456	0.408007
	30	9	45	35.52	28	55	18.6	0.259750	
	31	9	45	28.26	28	51	53.0	0.262064	045
April	1	9	45	22.76	28	48	16.5	0.264397	
	2	9	45	19.00	+28	44	29.2	0.066748	0.408085

r is the undisturbed radius-vector in the ellipse 1854 Jan. 0.0.

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THE
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OPPOSITION EPHEMERIS OF EUNOMIA FOR 1856.

By ERNEST SCHUBERT.

[Communicated by Commander C. H. Davis, Superintendent American Ephemeris.]

Mean Washington Noon.

1856.		⑮ α	⑮ δ	Log △	Log r
		h. m. s.	° ′ ″		
Aug.	29	1 13 14.07	+26 39 14.1	0.146507	0.336581
	30	13 8.54	47 40.0	0.143869	
	31	13 1.12	26 55 53.2	0.141256	0.336285
Sept.	1	12 51.81	27 3 53.3	0.138669	
	2	12 40.61	11 40.0	0.136111	0.335997
	3	12 27.52	19 12.8	0.133582	
	4	12 12.56	26 31.4	0.131084	0.335717
	5	11 55.73	33 35.5	0.128619	
	6	11 37.01	40 24.5	0.126189	0.335446
	7	11 16.49	46 58.2	0.123795	
	8	10 51.12	53 16.1	0.121439	0.335184
	9	10 29.93	27 59 18.0	0.119123	
	10	10 3.95	28 5 3.6	0.116848	0.334932
	11	9 36.18	10 32.4	0.114616	
	12	9 6.67	15 44.2	0.112429	0.334689
	13	8 35.44	20 38.5	0.110288	
	14	8 2.51	25 15.0	0.108193	0.334455
	15	7 27.92	29 33.4	0.106145	
	16	6 51.70	33 33.2	0.104148	0.334229
	17	6 13.90	37 14.1	0.102203	
	18	5 34.55	40 35.8	0.100313	0.334011
	19	4 53.70	43 38.0	0.098480	
	20	4 11.41	46 20.3	0.096705	0.333804
	21	3 27.72	48 42.4	0.094990	
	22	2 42.70	50 44.1	0.093336	0.333606
	23	1 56.33	52 25.2	0.091745	
	24	1 8.76	53 45.5	0.090219	0.333417
	25	1 0 20.15	54 44.9	0.088760	
	26	0 59 30.49	55 23.0	0.087369	0.333238
	27	58 39.80	55 39.9	0.086049	
	28	57 48.21	55 35.5	0.084800	0.333068
	29	56 55.81	55 9.8	0.083624	
	30	56 2.70	51 22.8	0.082523	0.332907
Oct.	1	55 8.95	53 11.6	0.081497	
	2	54 14.67	51 45.3	0.080548	0.332756
	3	53 19.94	49 55.2	0.079676	
	4	52 24.87	47 44.4	0.078883	0.332614
	5	51 29.56	45 13.2	0.078170	
	6	0 50 34.09	+28 42 21.9	0.077538	0.332481
Oct.	7	0 49 38.55	+28 39 10.7	0.076986	
	8	48 43.05	35 40.0	0.076517	0.332358
	9	47 47.69	31 50.1	0.076131	
	10	46 52.56	27 41.4	0.075828	0.332246
	11	45 57.74	23 14.3	0.075608	
	12	45 3.33	18 29.4	0.075471	0.332143
	☍ 13	44 9.42	13 27.1	0.075417	
	14	43 16.11	8 7.9	0.075447	0.332049
	15	42 23.48	28 2 32.4	0.075560	
	16	41 31.61	27 56 41.0	0.075757	0.331964
	17	40 40.59	50 34.4	0.076038	
	18	39 50.51	44 13.1	0.076402	0.331889
	19	39 1.44	37 37.9	0.076849	
	20	38 13.47	30 49.4	0.077379	0.331825
	21	37 26.68	23 48.3	0.077992	
	22	36 41.14	16 35.3	0.078688	0.331771
	23	35 56.93	9 11.3	0.079465	
	24	35 14.13	27 1 36.9	0.080321	0.331726
	25	34 32.80	26 53 53.0	0.081255	
	26	33 53.01	46 0.4	0.082268	0.331689
	27	33 14.82	37 59.9	0.083357	
	28	32 38.30	29 52.3	0.084524	0.331662
	29	32 3.52	21 38.6	0.085767	
	30	31 30.52	13 19.5	0.087085	0.331647
	31	30 59.34	26 4 55.8	0.088474	
Nov.	1	30 30.03	25 56 28.3	0.089934	0.331642
	2	30 2.64	47 57.8	0.091463	
	3	29 37.19	39 25.2	0.093059	0.331645
	4	29 13.71	30 51.2	0.094720	
	5	28 52.22	22 16.5	0.096445	0.331658
	6	28 32.76	13 41.9	0.098232	
	7	28 15.35	25 5 8.2	0.100079	0.331680
	8	27 59.98	24 56 36.1	0.101985	
	9	27 46.67	48 6.2	0.103947	0.331713
	10	27 35.45	39 38.8	0.105961	
	11	27 26.32	31 14.8	0.108036	0.331756
	12	27 19.28	22 54.4	0.110159	
	13	0 27 14.35	+24 14 38.2	0.112333	0.331809

☍ 1856, October 13, $23^{h.}$ $27^{m.}$ $17^{s.}.8$, Mean Time Washington. Intensity of light = 2.887.
r is the undisturbed radius-vector in the ellipse 1854, Jan. 0.0.

APPROXIMATE EPHEMERIS FOR THE YEAR.

Mean Washington Midnight.

1856.	⑮ α	⑮ δ	Log △	Log r	1856.	⑮ α	⑮ δ	Log △	Log r
	h. m	° ′				h. m.	° ′		
Jan. 1	19 34.28	—21 21.1	0.54633	0.40880	July 9	0 43.01	+16 33.0	0.29112	0.34694
11	19 53.02	20 13.2	0.54629	0.40535	19	0 53.11	18 47.0	0.26378	0.34455
21	20 11.73	18 56.5	0.54462	0.40188	29	1 1.58	20 57.8	0.23563	0.34233
31	30.35	17 32.0	0.54151	0.39839	Aug. 8	8.03	22 57.5	0.20682	0.34030
Feb. 10	20 48.79	15 59.1	0.53678	0.39489	18	12.07	24 48.9	0.17818	0.33845
20	21 7.03	14 18.6	0.53056	0.39138	28	13.30	26 26.1	0.15050	0.33681
March 1	25.02	12 30.9	0.52283	0.38787	Sept. 7	11.43	27 43.2	0.12497	0.33538
11	21 42.73	10 36.6	0.51363	0.38438	17	1 6.53	28 35.4	0.10315	0.33417
21	22 0.14	8 36.5	0.50295	0.38090	27	0 59.06	28 55.5	0.08668	0.33319
31	17.22	6 31.1	0.49085	0.37745	Oct. 7	50.07	28 40.6	0.07725	0.33245
April 10	33.97	4 21.1	0.47727	0.37404	17	41.07	27 53.5	0.07587	0.33194
20	22 50.35	— 2 7.4	0.46229	0.37068	27	33.53	26 41.8	0.08282	0.33168
30	23 6.36	+ 0 9.5	0.44586	0.36738	Nov. 6	28.67	25 17.8	0.09734	0.33166
May 10	21.97	2 28.7	0.42799	0.36415	16	27.15	23 54.1	0.11797	0.33189
20	37.11	4 49.7	0.40869	0.36100	26	29.07	22 40.4	0.14302	0.33235
30	23 51.75	7 11.6	0.38797	0.35795	Dec. 6	34.27	21 43.3	0.17080	0.33306
June 9	0 5.80	9 33.8	0.36581	0.35500	16	42.35	21 4.6	0.19992	0.33400
19	19.12	11 55.1	0.34224	0.35218	26	0 52.88	20 44.6	0.22935	0.33517
29	0 31.60	+14 15.4	0.31732	0.34949	36	1 5.49	+20 41.7	0.25835	0.33660

DETERMINATION OF THE ELEMENTS OF EUNOMIA AND MELPOMENE.

By ERNEST SCHUBERT.

[Report to Commander C. H. Davis, Superintendent American Ephemeris.]

Normal Places referred to Mean Equinox of 1854, Jan. 0.

EUNOMIA.

M. T. Berlin.	⑮ α	No. of Obs.	⑮ δ	No. of Obs.
	° ′ ″		° ′ ″	
1851, Aug. 20.5	271 57 19.76	21	—24 27 41.28	17
Oct. 14.5	281 1 53.29	20	—21 6 54.59	19
1852, Jan. 3.5	313 46 58.27	10	—12 41 35.93	9
July 19.5	49 6 27.33	8	+28 59 10.56	9
Nov. 17.5	78 3 2.30	8	+37 12 9.20	8
1853, Jan. 8.5	66 35 15.96	9	+30 46 35.07	11
1854, Mar. 13.5	174 6 44.57	18	—14 27 46.74	18

MELPOMENE.

M. T. Berlin.	⑱ α	No. of Obs.	⑱ δ	No. of Obs.
	° ′ ″		° ′ ″	
1852, July 1.0	271 35 16.53	17	— 8 35 16.00	16
Oct. 1.0	274 56 46.92	19	—18 21 28.78	17
1853, Jan. 1.0	322 28 46.75	9	—16 2 17.53	10
Oct. 26.0	129 2 40.49	5	+10 7 59.37	5
1854, Jan. 28.0	128 3 16.18	17	+12 2 48.34	18
1855, Apr. 26.0	223 23 31.65	16	— 0 58 16.38	16

Perturbations of the Coördinates by *Jupiter and Saturn*, for the dates of the normal places, expressed in units of the 7th decimal, and counted from the epoch 1854.0.

Date	$x - x_0$	$y - y_0$	$z - z_0$
1851, Aug. 20	+44637	+ 5261	+11542
Oct. 14	38176	10796	13052
1852, Jan. 3	26476	15826	13196
July 19	4018	10596	5780
Nov. 17	1050	4620	2209
1853, Jan. 8	824	3084	1459
1851, Mar. 13	+ 49	+ 110	+ 62

Date.	$x - x_0$	$y - y_0$	$z - z_0$
1852, July 1	+4822	+3301	+ 595
Oct. 1	4758	3857	945
1853, Jan. 1	2786	3861	1159
Oct. 26	11	107	50
1854, Jan. 28	+ 2	19	8
1855, Apr. 26	— 404	+4563	+1883

Corrected Elements.

EUNOMIA.

Epoch, 1854, Jan. 0, M. T. Washington.

	° ′ ″
M	122 10 31.2
π	27 47 12.1
☊	293 55 42.0
i	11 41 5.2
φ	10 50 11.9
μ	825″.79753
Log μ	2.9168736
Log a	0.4220887

Sum of squares of residual errors in fourteen equations of condition = 17″.57.

Probable error of $\mu = \pm$ 0″.00670.

MELPOMENE.

Epoch, 1854, Jan. 0, M. T. Washington.

	° ′ ″
M	79 56 59.1
π	15 14 13.6
☊	150 1 5.2
i	10 9 4.8
φ	12 32 46.1
μ	1019″.979980
Log μ	3.0085917
Log a	0.3609433

Sum of squares of residual errors in fourteen equations of condition = 90″.88.

Probable error of $\mu = \pm$ 0″.00726.

OBSERVATIONS OF IRIS, PROSERPINA, AND EUPHROSYNE.

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By JAMES FERGUSON.

[Communicated by Lieutenant MAURY. —Corrected for refraction.]

IRIS.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑦ − ∗		⑦'s apparent	
				$\Delta\alpha$	$\Delta\delta$	α	δ
1855.	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
Dec. 18	9 36 30.3	4	B. Z. 524, 72	+1 34.14	+2 24.45	5 50 20.18	+22 0 7.86
		4	" 524, 73	+0 51.73	−3 45.64	5 50 20.30	+22 0 6.82

Adopted Mean Places, 1860.0, of Comparison-Stars.

∗	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 524, 72	8.9	5 48 59.80	+21 57 39.83	Bessel's Zones.
" 524, 73	9	5 49 39.31	+22 3 48.66	"

PROSERPINA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉖ − ∗		㉖'s apparent	
				$\Delta\alpha$	$\Delta\delta$	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1855, Dec. 18	8 31 26.8	5	B. Z. 521, 25	+0 7.58	+12 44.37	4 19 47.42	+24 0 18.37
1856, Jan 4	7 23 14.7	5	" 521, 8	+1 3.17	− 5 49.14	4 7 48.90	+23 36 59.48
6	7 54 41.3	5	" 521, 8	+0 6.24	− 7 45.90	4 6 51.96	+23 35 2.75
9	6 41 19.5	4	" 521, 8	−1 4.23	−10 29.68	4 5 41.48	+23 32 19.08

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 521, 25	8.9	4 19 53.73	+23 47 59.66	Bessel's Zones.
" 521, 8	8	4 6 59.58	+23 43 17.94	"

EUPHROSYNE.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉛ — * Δα	㉛ — * Δδ	㉛'s apparent α	㉛'s apparent δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
*1855, Sept. 8	15 41 50.2	8	B. Z. 425, 126	+1 29.57	— 3 52.09	8 20 37.60	+40 20 49.44
	15 55 14.3	3	" 425, 124	+3 29.47	— 0 51.41	8 20 38.80	40 20 50.62
		3	" 425, 125	+2 29.41	+ 1 59.98	8 20 38.79	40 20 48.06
17	15 44 34.9	3	" 450, 12	+2 51.13	+ 6 22.61	8 41 25.32	40 13 52.88
	16 6 35.2	10	" 450, 14	+0 54.58	+ 6 31.25	8 41 27.54	40 13 59.17
Oct. 10	15 9 8.2	10	" 450, 82	—0 52.74	+11 15.84	9 31 31.45	39 47 47.98
Nov. 14	13 2 27.6	12	" 498, 52	—1 20.24	+ 0 12.87	10 35 46.08	39 41 58.73
1856, Feb. 17	9 25 34.7	6	A. Z. 178, 61	+2 5.30	—19 22.79	10 54 51.21	48 7 45.11
20	9 6 12.9	3	" 178, 61	—1 50.83	—18 41.38	10 50 55.11	48 8 27.05
21	8 39 50.3	12	" 178, 58	+0 55.48	+ 9 54.60	10 49 37.63	48 7 53.79
Mar. 5	9 20 1.2	6	" 178, 38	+1 7.87	— 9 35.06	10 32 41.79	47 25 50.17
15	9 23 16.0	5	" 98, 25	+1 44.37	+14 43.77	10 21 41.58	46 11 32.28
19	7 57 1.9	4	" 98, 25	—1 46.75	—22 50.52	10 18 10.45	45 33 58.41
24	8 8 21.1	8	Σ. Cat. G. 1198	+1 2.29	+ 2 33.72	10 14 22.18	44 40 21.13
25	7 52 21.3	8	" 1198	+0 23.86	— 8 40.20	10 13 43.74	44 29 7.48
29	10 39 44.6	4	B. Z. 497, 53	+1 29.11	— 6 7.90	10 11 22.52	43 40 9.72
31	12 44 41.1	8	" 497, 51	+1 50.60	— 7 7.69	10 10 24.87	43 14 16.73
Apr. 6	11 50 9.9	10	" 451, 41	+0 25.98	— 3 14.56	10 8 26.33	41 56 17.62
8	10 34 2.1	4	B. A. C. 3466	+5 43.10	+ 7 49.22	10 8 2.28	41 30 0.14
22	10 43 40.3	3	" 3468	+5 51.98	+ 3 48.10	10 8 33.54	38 10 31.47
	10 54 43.5	7	B. Z. 407, 87	—1 21.46	— 3 21.17	10 8 33.97	+38 10 21.16

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 425, 126	8	8 19 27.09	+40 23 45.23	Bessel's Zones.
" 425, 124	7	8 17 28.41	40 20 45.86	B.Z., Rümker's Cat., and Radcliffe Obs.
" 425, 125	8	8 18 28.44	40 17 52.31	Radcliffe Obs.
" 450, 12	8.9	8 38 52.73	40 6 28.98	Bessel's Zones.
" 450, 14	9	8 40 51.48	40 6 26.03	"
" 450, 82	7.8	9 32 41.32	39 35 20.23	Struve, Cat. Gen., and Radcliffe Obs.
" 498, 52	9	10 37 21.38	39 40 30.27	Bessel's Zones.
A. Z. 178, 61	7	10 52 57.48	48 25 57.47	Argelander's Zones.
" 178, 58	9	10 48 53.87	47 56 48.65	" "
" 178, 38	7	10 31 45.83	47 34 12.11	" "
" 98, 25	6.7	10 20 9.37	45 55 34.19	Argelander's Zones, and Radcliffe Obs.
Σ. Cat. G. 1198	7.8	10 13 32.24	44 36 32.20	Struve, Catalogus Generalis.
B. Z. 497, 53	7	10 10 5.86	43 45 1.72	Radcliffe.
" 497, 51	8.9	10 8 46.76	43 20 8.51	Bessel's Zones.
" 451, 41	8	10 8 12.87	41 58 15.72	" "
B. A. C. 3466	6	10 2 31.85	41 20 54.91	B. A. Cat. and Radcliffe Obs.
" 3468	6.7	10 2 54.26	38 5 26.27	" " "
B. Z. 407, 87	8	10 10 7.97	+38 12 24.45	Bessel's Zones.

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* The observations of Sept. 8 and 17 have already been published, *Astronomical Journal*, No. 88. An error made then in the reduction of the declination is corrected here.

THE PROBLEM OF THE TIDES

WITH REGARD TO OSCILLATIONS OF THE SECOND KIND.

By W. FERREL, A.M.,
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It is known to those who are conversant with La Place's theory of the tides, that, in the solution of the problem with regard to oscillations of the second kind, he obtained the remarkable result, that if the whole surface of the earth were covered by a sea of uniform depth, the diurnal tides, which are produced by these oscillations, would vanish. Although La Place seems to have regarded this as one of his most happy discoveries, and notwithstanding Professor Airy has since arrived at the same result by a somewhat different analysis (*Encyclopædia Metropolitana*, *Tides and Waves*, p. 102), yet we are persuaded that the solutions of both these distinguished mathematicians are defective, and that the results which they have obtained are erroneous, or at least not applicable to the problem when properly restricted, or even as restricted by La Place himself. We propose, therefore, to point out, in the first place, what we conceive to be defects in these solutions, and to give some reasons for considering the results erroneous; and, secondly, to give what we consider a more satisfactory solution of the problem. In doing this, we must, for the sake of brevity, avail ourselves as much as possible of what has been given on the subject, and hence frequent reference will be made to Bowditch's Commentary on the *Mécanique Céleste*.

La Place has correctly obtained the three equations (2175 — 2176′), which express the conditions of the equilibrium of the forces, and which must be satisfied in the solution of the problem; and these are substantially the same as those obtained by Professor Airy (*Tides and Waves*, p. 87), differing only in form and notation. As the solution of the problem in its most general form is impracticable, both La Place and Professor Airy limit themselves to the case in which the depth of the sea is a function of the latitude only; and after substituting for y, u, v, &c., their assumed values in (2178 — 2178‴), and eliminating b and c, La Place obtains the equation (2183). With regard to this equation he says (2191) that "*in the general case where* n *does not vanish, and the depth of the sea is variable, the integration of the equation* (2183) *surpasses the power of analysis; but to determine the oscillations of the ocean, it is not necessary to integrate it generally, since it is sufficient merely to satisfy it.*" Accordingly, he assumes that the equation can be satisfied by the function $a = Q\,\mu\,\sqrt{1-\mu}$ (2144), Q being independent of μ, and finds that it will satisfy it when $Q = 0$, which makes the tide vanish. But in questions involving the conditions of the equilibrium of forces, there may sometimes be more than one result which satisfies the conditions, as might be shown in numerous cases, only one of which gives a stable equilibrium of the forces, or the problem may be indeterminate, as will be shown in this case, in which an infinite number of results may satisfy the conditions, only one of which may be applicable to the problem where friction or any disturbing influences are concerned. We think, therefore, that the principle above, laid down by La Place, is a little too broad, and that it is *not sufficient* merely to satisfy the equation; and consequently that his solution is defective, inasmuch as there is nothing in his analysis by which to determine whether the function above, although it satisfies the equation, may not give an unstable equilibrium only of the forces, or whether there may not be other functions which will also satisfy the equation, and whether the consequent motions of the sea, as deduced from all of them, may not depend upon a primitive impulse of the sea, and not upon the action of the disturbing body. For La Place's analysis only shows that the sea might be indued with certain oscillatory motions produced by some primitive impulse, which would satisfy the equation of continuity (2175), and which would also give such values to the first two terms of (2176, 2176′) as would exactly counteract the tangential forces of the disturbing body expressed by the last terms; for in this case the tide must vanish, and consequently the third terms. But if the motions of the sea which satisfy these equations upon the hypothesis that $a = 0$, depend upon primitive impulse, the results deduced from such an hypothesis, although the equations are satisfied, must be rejected as inapplicable to the problem; for, as La Place himself says (2191″), such motions must quickly disappear by the resistances of various kinds which the waters of the sea suffer in their motions. And that the results which La Place has obtained do depend upon motions of this kind may be shown without going into an elaborate investigation of the subject, by applying them to the case in which n or the rotatory motion of the earth approximates to 0; for a result can frequently be shown to be erroneous more conveniently and satisfactorily by showing that it fails in extreme cases, than in any other way. Now if the motions of the sea which satisfy the equations for La Place's result of $a = 0$, do not depend upon a primitive impulse independent of the action of the disturbing body, the same must be true for all values of n, however small; for all the equations were obtained upon the hypothesis of small motions. Hence, as n approximates to 0, that is, as the rotatory motion of the earth approximates to a state of rest, the motions of the sea should also approximate to that state.

But it may be seen by examining the equations of La Place (2260, 2261), which express the motions of the sea, that as n approximates to 0, u and v, and consequently $\frac{du}{dt}$ and $\frac{dv}{dt}$, which express the velocities of these motions, approximate towards infinity. There must then be other results which satisfy the equations than those which satisfy the equations when $a = 0$, which make the motions of the sea vanish as n vanishes; and it is only when the problem is restricted to the condition that $a = 0$ that larger motions are required to satisfy the equations as n decreases.

We shall now endeavor to give a direct solution of the problem which will verify what has been stated, and which is not only applicable to the particular case in which $i = n$, but holds good for any value of i, and for any law of the depth, expressed by a function which admits of being developed into a series containing the even powers of the sines and cosines of the latitude. We shall commence the solution with La Place's fundamental equation (2183), changing a little its notation. If in this equation we use $\cos\theta$ for μ, and restore the value of z in (2182), remembering that $s = 1$ in oscillations of the second kind, it may be reduced to the following form:

$$\frac{i \sin\theta \, . \, a}{g} = \frac{d}{d\theta} \left\{ \gamma \frac{2n\cos\theta\, a' + i \sin\theta \frac{d a'}{d\theta}}{4n^2\cos^2\theta - i^2} \right\} - \gamma \, . \, \frac{2n\sin\theta\cos\theta \frac{d a'}{d\theta}}{\sin\theta\,(4n^2\cos^2\theta - i^2)} \, . \qquad \text{(A.)}$$

Differentiating, and multiplying by $\sin\theta\,(4n^2\cos^2\theta - i^2)^2$, it becomes

$$\begin{aligned} \frac{i\sin^2\theta}{g}(4n^2\cos^2\theta - i^2)^2\, a = {} & \frac{d\,d\,a'}{d\theta}\gamma\,(4n^2\cos^2\theta - i^2)\, i \sin^2\theta \\ & + \frac{d a'}{d\theta}\left\{ \gamma\,(8n^2\sin^2\theta + 4n^2\cos^2\theta - i^2)\, i\sin\theta\cos\theta + \frac{d\gamma}{d\theta}(4n^2\cos^2\theta - i^2)\, i \sin^2\theta \right\} \\ & + a' \, . \, \gamma\,(i^3 + 2n\,i^2\sin^2\theta - 4n^2 i\cos^2\theta + 8n^3\sin^2\theta\cos^2\theta) \qquad \text{(B.)} \\ & + a' \, . \, \frac{d\gamma}{d\theta}(4n^2\cos^2\theta - i^2)\, 2n\sin\theta\cos\theta \\ & - a'\,(4n^2\cos^2\theta - i^2)\sin^2\theta . \end{aligned}$$

Again, from (2178), (2178‴), and (2223), using only the part of V′ depending on the action of the disturbing body, and putting $K = \frac{ak}{g}$ we obtain

$$a = K \sin\theta\cos\theta + a' . \qquad \text{(C.)}$$

We shall omit the small part of V′ depending upon the attraction of the stratum of water by which the sea is elevated above, or depressed below, the general level, as Professor Airy has done, and also La Place (2280‴) in his solution for oscillations of the third kind.

Combining the last equation with the preceding, putting $i = e\,n$, and $\gamma = l\,(1 + q\sin^2\theta + r\sin^4\theta + \text{\&c.})$, we get

$$\begin{aligned} \frac{n^2}{g\,l}(K\sin\theta\cos\theta + a')\,(4 - e - 4\sin^2\theta)^2\sin^2\theta = {} & \frac{d\,d\,a'}{d\theta^2}\left\{ (4e - e^3)\sin^2\theta + (4e - 4eq + e^3 q)\sin^4\theta + \text{\&c.} \right\} \\ & + \frac{d a'}{d\theta} e \sin\theta\cos\theta \left\{ \begin{aligned} & 4 - e^2 + (4 + 4q + 8eq - e^2 q - 2e^3 q)\sin^2\theta \\ & + (4q - 8eq + 4r + 16er - e^2 r - 4e^3 r)\sin^4\theta + \text{\&c.} \end{aligned} \right\} \qquad \text{(D.)} \\ & + a' \left\{ \begin{aligned} & -4e + e^3 + (8 + 4e + 2e^2 - 4eq + 16q - 4e^2 q)\sin^2\theta \\ & + (-8 + 8q + 4eq - 2e^2 q + 32r - 4er + 8e^2 r - e^3 r)\sin^4\theta + \text{\&c.} \end{aligned} \right\} \end{aligned}$$

The value of e in this equation differs very little from unity, being only $\frac{1}{365}$ less for the sun, and $\frac{1}{27}$ nearly for the moon.

In order to satisfy this equation we must put

$$a' = A^{(0)} + A\sin\theta + A^{(3)}\sin^3\theta + A^{(5)}\sin^5\theta \ldots + A^{(m)}\sin^m\theta . \qquad \text{(E.)}$$

If we substitute this value of a' in the preceding equation, and develop $\cos\theta$, and then compare the coefficients of like powers of $\sin\theta$, we shall obtain equations from which we can determine $A^{(0)}$, A, $A^{(3)}$, &c., and hence the value of a in equation (C).

For the sake of simplicity, we shall carry out the solution for the particular case only in which $i = n$, and $q = 0$, as it may be readily seen from this how the solution may be extended to the more general cases.

Putting $e = 1$ and $q = 0$, equation (D) becomes

$$\begin{aligned} \frac{n^2}{g\,l}(K\sin\theta\cos\theta + a)\,(9\sin^2\theta - 24\sin^4\theta + 16\sin^6\theta) = {} & \frac{d\,d\,a'}{d\theta^2} 3\sin^2\theta - 4\sin^4\theta) \\ & + \frac{d a'}{d\theta}(3\sin\theta\cos\theta + 4\sin^3\theta\cos\theta) \qquad \text{(F.)} \\ & + a'\,(-3 + 14\sin^2\theta - 8\sin^4\theta). \end{aligned}$$

The value of a' in equation (E) being substituted in this equation, we get, by comparing coefficients as stated above,

$$\begin{aligned} A^{(0)} &= 0 \\ A &= A \text{ (indeterminate)}, \\ A^{(3)} &= -\tfrac{1}{2} A + \frac{3}{8} \cdot \frac{n^2}{g\,l} (A + K) \\ A^{(5)} &= -\tfrac{1}{8} A + \frac{11}{96} \cdot \frac{n^2}{g\,l} (A + K) + \frac{3}{64} \cdot \frac{n^4}{g^2\,l^2} (A + K) \\ A^{(7)} &= -\tfrac{1}{16} A + \frac{2623}{10368} \cdot \frac{n^2}{g\,l} (A + K) - \frac{51}{4608} \cdot \frac{n^4}{g^2\,l^2} (A + K) + \frac{3}{1024} \cdot \frac{n^6}{g^3\,l^3} (A + K)\,; \end{aligned} \tag{G.}$$

and generally after $A^{(7)}$, putting m successively equal to the odd numbers 7, 9, &c.,

$$\begin{aligned} 3\,(m+1)\,(m-1)\,A^{(m)} = {} & (7\,m^2 - 33\,m + 24)\,A^{(m-2)} - 4\,(m-6)\,(m-3)\,A^{(m-4)} \\ & + (9\,A^{(m-2)} - 24\,A^{(m-4)} + 16\,A^{(m-6)})\,\frac{n^2}{g\,l} \\ & + \left(9\,.\,\frac{m-6}{m-3} \cdot \frac{m-8}{m-5} \cdots - \frac{1}{2} - 24\,\frac{m-8}{m-5} \cdot \frac{m-10}{m-7} \cdots - \frac{1}{2} + 16\,\frac{m-10}{m-7} \cdot \frac{m-12}{m-9} \cdots - \frac{1}{2}\right) \frac{n^2}{g\,l}\,K\,. \end{aligned} \tag{H.}$$

In comparing the coefficients of sin θ, we get $3\,A - 3\,A = 0$, or $A = A$. Hence any assumed value of A will satisfy this equation, and if we use this same value in the other equations in (G, H) in determining $A^{(5)}$, $A^{(7)}$, &c., we shall obtain a result for a' in (E), which will satisfy (F), and consequently the conditions of the problem. The problem is therefore indeterminate, and may be satisfied with any assumed value of A, even when $K = 0$. But as the motions of the sea depend upon a', as may be seen from La Place's equations (2178', 2178''', 2180, 2181), if we assume A too large, it will give values to u and v larger than those contemplated in determining the fundamental equations, for they were determined upon the hypothesis of small motions, and hence the result would not be correct.

We have said that the problem is indeterminate; but this is the case only when the motions of the sea are made to depend wholly, or in part, upon a primitive impulse. For if we examine the equations (G, H), it may be seen that the result for any assumed value of A would depend in part only upon K, or the disturbing body, and in part upon A, which must in this case represent the primitive impulse by which the sea received such motions as would satisfy the conditions of the problem. But as these motions, either wholly or in part, would be independent of the disturbing body, and we can conceive of no circumstances which could produce them, and as they must quickly disappear on account of friction, if they were produced, the problem, as it really exists in nature, becomes entirely determinate. For, in this case, we must put $A = 0$, and then the result will depend entirely upon K, and the motions of the sea be reduced to the minimum which can satisfy the conditions of the problem, as they evidently must where friction is concerned.

We shall now determine whether any assumed value of A will cause the tides to vanish, and thus make our result correspond in a particular case with that of La Place. In order to do this, it may be seen from equation (C), that we must satisfy the equation

$$0 = K \sin\theta \cos\theta + a'\,. \tag{I.}$$

Developing the first term of the last member of this equation, and comparing the coefficients of the same powers of sin θ, using for a' its value in (E), we obtain

$$A^{(0)} = 0, \quad A = -K, \quad A^{(3)} = +\tfrac{1}{2}\,K, \quad A^{(5)} = +\tfrac{1}{8}\,K, \quad A^{(7)} = +\tfrac{1}{16}\,K,$$

and generally

$$A^{(m)} = -\left(\frac{m-4}{m-1} \cdot \frac{m-6}{m-3} \cdots - \frac{1}{2}\right) K. \tag{J.}$$

Hence,

$$A^{(m-2)} = -\left(\frac{m-6}{m-3} \cdot \frac{m-8}{m-5} \cdots - \frac{1}{2}\right) K\,; \text{ and } A^{(m-4)} = -\left(\frac{m-8}{m-5} \cdot \frac{m-10}{m-7} \cdots - \frac{1}{2}\right) K. \tag{K.}$$

If we now put these values of $A^{(0)}$, A, $A^{(3)} \ldots A^{(m)}$ respectively equal to those in (G, H), the equations thus obtained will all be satisfied by putting $A = -K$. Hence the result obtained by assuming $A = -K$ will satisfy both the conditions of the problem and the equation (I), which makes the tide vanish, and this is precisely La Place's result. But as any result, as we have seen, except the one obtained by making $A = 0$, makes the motions of the sea depend in part upon a primitive impulse, which must quickly disappear, if it could even receive such impulse, this result is not applicable to the problem, unless it were required merely to determine what motions the sea must have to produce a merely theoretical equilibrium of the forces, which could not be permanent where there is friction.

If we now take the more general equation (D), and compare the coefficients of sin θ, as above, we shall get $(4\,e - e^3)\,A = 4\,e - e^3\,A$, in which A is again arbitrary and indeterminate, and hence if we assume any value for A, and use it in determining $A^{(3)}$, $A^{(5)}$, &c., we shall obtain a result which will satisfy the conditions of the problem in this case also. But it would be impossible in this case to satisfy the equation (I) with any assumed value of A, and hence, in this more general case, the tides could not be made to vanish by means of any primitive impulse.

It may be remarked here, that a similar result of indeterminateness was obtained by La Place in his solution for oscillations of the third kind (2288), which he failed to interpret rightly, and which has been since explained by Professor Airy (*Tides and Waves*, pp. 111, 112) somewhat as above, except that he furnished no criterion by which to determine what part of the result depends upon the disturbing body, and what upon primitive impulse; and hence left the result entirely indeterminate. According to the interpretation above, La Place in his general equation of the coefficients (2289) should have put $A^{(s+1)} = 0$, which would have simplified the problem very much, and have given the minimum result for the motions of the sea which could satisfy the conditions of the problem, which is evidently, from what precedes, the only one strictly applicable to the problem. This would have changed his result very much; for instead of a difference of 36 feet (2306) between high and low water at the equator, when the depth of the sea is $5\frac{1}{2}$ miles, it would have given less than one foot, which is more in accordance with observation; for the tides in the Pacific in the open sea are found to be very small.

We think it is therefore evident that *any* assumption that will satisfy La Place's equation (2183) will not furnish a true result, inasmuch as it would make the tides depend upon a primitive impulse; and this is still further evident from the fact, that this equation may be satisfied in this way for oscillations of both the second and third kind, and a result obtained which would give very large tides, even in the case in which the disturbing force vanishes.

Nashville, Tenn., 1856, *May* 24.

ON THE OBSERVATION OF THE ASTEROIDS.

Professor Brunnow, director of the Observatory at Ann Arbor, writes under date of June 3, stating his gratification at the initiative taken by Lieutenant Maury, in behalf of the Washington Observatory, in carrying out the suggestions for a division of labor in observing the small planets. He expresses the hope that his observatory will in a very few weeks be in sufficient order to permit the commencement of regular observations with the refractor, and his willingness to undertake, in behalf of the Ann Arbor Observatory, the regular observation of the eight following asteroids: —

Flora,
Clio,
Astrea,
Metis,
Proserpina,
Calliope,
Euphrosyne,
Hebe.

Professor Brunnow is at present engaged upon tables of *Clio*, and hopes before long to undertake the preparation of tables for yet other members of the asteroid group.

In order to facilitate and hasten this division of labor, so far as regards the observation of the asteroids, the Editor undertakes to guarantee that four others shall be also regularly observed in the United States after the beginning of the year 1857, and selects the four following as least likely to interfere with the preferences of others.

Vesta,
Iris,
Eunomia,
Amphitrite.

These will complete for the Western Continent its contingent of one half the known members of the group; and there is little doubt that steps will soon be taken toward the assumption of an equitable proportion of the labor of computing elements, and providing ephemerides.

G.

Cambridge, 1856, *June* 6.

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THE

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ON THE ASYMPTOTIC VALUES OF THE COEFFICIENTS IN THE DEVELOPMENT OF ANY POWER OF THE RADIUS-VECTOR ACCORDING TO THE MEAN ANOMALY.

By PROFESSOR WILLIAM SCHEIBNER.

1. In Nos. 665 and 709 – 712 of Schumacher's *Astronomische Nachrichten* is contained a memoir[*] by C. G. J. Jacobi in which the coefficients of the trigonometric functions of very large multiples of the mean anomaly, in the development of the radius vector and of the equation of the center, are approximately determined. The method upon which this memoir is based had already been unfolded by Carlini in 1817 in a special dissertation; but Carlini's results were nevertheless affected with various errors, and it was on account of this circumstance that Jacobi undertook the re-investigation to which I have alluded. It cannot be said that the course which he pursued leads easily to the desired end; and, indeed, the problem in relation to the equation of the center was designated by Jacobi as one of the most difficult of its class. The consideration that the coefficients in the equation of the center coincide with those in the development of $\left(\frac{a}{r}\right)^2$ prompted me to examine whether, for the development of any power of the radius-vector, formulas might not be given, in which the problems investigated by Jacobi must occur as special cases. The experiment was successful, and by means of a peculiar and very general method, which recommends itself by the brevity and ease of the calculation, I have deduced a result which fully corroborates the accuracy of the expressions found by Jacobi, and retains its application for each and every positive or negative power of the radius-vector. This result I propose now to deduce and develop, endeavoring at the same time to put its accuracy beyond all doubt by means of various considerations.

2. Let n denote any positive or negative exponent, g the mean anomaly, φ the angle of eccentricity, r the radius-vector, and a the semi-axis major, and put

$$\left(\frac{a}{r}\right)^n = c_0^n + 2\,\Sigma_{p=1}^{\infty}\, c_p^n \cos p\,g.$$

Then we shall have for the value of the coefficient c_p^n a series arranged according to increasing powers of $\sqrt{p}$, which belongs to the class of the so-called semi-convergent series, and which may be employed in computation for large values of p in its initial terms. Calling c the base of the natural system of logarithms, and writing according to Legendre's notation and Gauss's definition

$$\Gamma p = \lim.\ \frac{1\,.\,2\,.\,3\,.\,.\,.\,.\,.\,m}{p\,.\,p+1\,.\,p+2\,.\,.\,.\,.\,.\,p+m-1}\, m^{p-1} \qquad \text{for } m = 0,$$

we shall have

$$c_p^n = p^{\frac{n-2}{2}}\,(2\cos\varphi)^{-\frac{n}{2}}\,\mathrm{tg}^p\,\tfrac{1}{2}\varphi\; e^{p\cos\varphi}\left\{\frac{A}{\Gamma\frac{n}{2}} + \frac{n}{3\cos\varphi}\sqrt{\frac{2}{p\cos\varphi}}\cdot\frac{B}{\Gamma\frac{n-1}{2}}\right\}$$

in which A and B will denote the series

$$A = 1 - \frac{n\,(n-2)}{8\,p\cos\phi}\,.\,(1) + \frac{n\,(n-2)\,(n-4)}{64\,p^2\cos^2\phi}\,.\,(2)\,.\,.\,.\,.\,.$$

$$B = 1 - \frac{n-3}{8\,p\,\cos\phi}\,.\,[1] + \frac{(n-3)\;n-5}{320\,p^2\cos^2\phi}\,.\,[2]\,.\,.\,.\,.\,.$$

In these equations, for brevity, is put

$$(1) = 1 - \frac{4\,n+11}{9\,\cos^2\phi}$$

$$[1] = \frac{5\,n+11}{5} - \frac{4\,n^2+33\,n+59}{27\cos^2\phi}$$

$$(2) = \frac{n+2}{2} - \frac{20\,n^2+143\,n+222}{45\,\cos^2\phi} + \frac{16\,n^3+261\,n^2+1307\,n+1878}{486\,\cos^4\phi}$$

$$[2] = \frac{35\,n^2+224\,n+317}{14} - \frac{20\,n^3+297\,n^2+1324\,n+1719}{27\,\cos^2\phi} + \frac{16\,n^4+440\,n^3+4175\,n^2+15880\,n+19809}{486\,\cos^4\phi}\,.$$

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[*] See Vol. XXVIII. pp. 257 – 270, and Vol. XXX. pp. 197 – 254.

The expression given for c_p^n holds equally good, not merely for integral, rational, and irrational values of n, but also for any value of φ, no matter how small the eccentricity may be taken. The sole exceptions are formed as is evident by the values $p=0$ and $\cos\varphi=0$ or $\varphi=90°$, for which the development as given is not applicable.

In order to deduce the cases discussed by Jacobi we put $n=2$, and $n=-1$, which furnish the expressions

$$c_p^2=(\operatorname{tg}\tfrac{1}{2}\varphi\, e^{\cos\varphi})^p\,\frac{1}{2\cos\phi}\left\{1+\frac{2}{3\cos\phi}\sqrt{\frac{2}{p\pi\cos\phi}}\left[1+\frac{1}{8p\cos\phi}\left(\frac{21}{5}-\frac{47}{9\cos^2\phi}\right)+\frac{1}{64p^2\cos^2\phi}\left(\frac{543}{14}-\frac{127}{\cos^2\phi}+\frac{1601}{18\cos^4\phi}\right)\cdots\cdots\right]\right\}$$

$$c_p^{-1}=-(\operatorname{tg}\tfrac{1}{2}\varphi\, e^{\cos\varphi})^p\sqrt{\frac{\cos\phi}{2\pi p^3}}\left\{1-\frac{3}{8p\cos\phi}\left(1-\frac{7}{9\cos^2\phi}\right)-\frac{15}{64p^2\cos^2\phi}\left(\frac{1}{2}-\frac{11}{5\cos^2\phi}+\frac{91}{54\cos^4\phi}\right)\cdots\cdots\right\}.$$

If, now, the different notations be reduced to one another, we shall find that Jacobi's equations

$$P=\frac{2\cos\phi}{p}\,c_p^2=\frac{1}{p}(\alpha\, i')^p\left\{1+\frac{4}{3}\frac{1}{\sqrt{2\pi p f^3}}\right\}$$

$$Q=2\,c_p^{-1}=-(\alpha\, i')^p\,\frac{2f}{p\sqrt{2\pi p f}}\left\{1-\left(\frac{3}{8f}-\frac{7}{24f^3}\right)\frac{1}{p}\right\}$$

are in perfect accordance with the values given above.

If we denote by I_λ^p the function

$$I_\lambda^p=\frac{\lambda^p}{p\,!}-\frac{\lambda^{p+2}}{1\,!\,(p+1)\,!}+\frac{\lambda^{p+4}}{2\,!\,(p+2)\,!}-\frac{\lambda^{p+6}}{3\,!\,(p+3)\,!}\pm\cdots\cdots$$

and put $\lambda=\frac{1}{2}p\sin\varphi$, it is well known that

$$\frac{a}{r}=1+2\,\Sigma_{p=1}^{\infty}\,I_\lambda^p\cos p\,g$$

$$\frac{r}{a}=1+\tfrac{1}{2}\sin^2\varphi-2\,\Sigma_{p=1}^{\infty}\,\frac{\lambda}{p^2}\frac{dI}{d\lambda}\cos p\,g\,.$$

Consequently, by writing in our formula $n=1$, it gives

$$c_p^1=I_\lambda^p=\operatorname{tg}^p\tfrac{1}{2}\varphi\, e^{p\cos\varphi}\frac{1}{\sqrt{2p\pi\cos\varphi}}\left\{1+\frac{1}{2p\cos\phi}\left(1-\frac{5}{3\cos^2\phi}\right)+\frac{7}{64p^2\cos^2\phi}\left(\frac{9}{14}-\frac{11}{3\cos^2\phi}+\frac{55}{18\cos^4\phi}\right)\cdots\cdots\right\};$$

and it can be easily verified that the value of $c_p^{-1}=\dfrac{\lambda}{p^2}\dfrac{dI}{d\lambda}$ may be hence deduced by differentiation with reference to λ.

3. Much more general formulas for confirmation of the correctness of our results may be deduced in the following manner. Putting

$$\frac{r}{a}=1-\sin\varphi\cos u\,,$$

in which therefore

$$u=g+\sin\varphi\sin u$$

denotes the eccentric anomaly, the differentiation relatively to g and φ gives

$$\frac{d\frac{r}{a}}{dg}=\frac{a}{r}\sin\varphi\sin u\ ;\quad \frac{du}{dg}=\frac{a}{r};$$

$$\operatorname{tg}\varphi\frac{d\frac{r}{a}}{d\phi}=1-\cos^2\varphi\,\frac{a}{r}\ ;\quad \frac{du}{d\phi}=\frac{a}{r}\cos\varphi\sin u\,.$$

By the aid of these expressions, we are enabled to differentiate the equation

$$\left(\frac{a}{r}\right)^n=c_0^n+2\,\Sigma_{p=1}^{\infty}\,c_p^n\cos p\,g$$

in like manner relatively to g and φ, and will begin with the differentiation in reference to g. By this we have

$$n\left(\frac{a}{r}\right)^{n+2}\sin\varphi\sin u=2\,\Sigma\,p\,c_p^n\sin p\,g\,,$$

and by repetition

$$n\left(\frac{a}{r}\right)^{n+3}\sin\varphi\cos u-n\,(n+2)\left(\frac{a}{r}\right)^{n+4}\sin^2\varphi\sin^2 u=2\,\Sigma\,p^2\,c_p^n\cos p\,g\,.$$

The elimination of u gives

$$n\,(n+1)\left(\frac{a}{r}\right)^{n+2}-n\,(2n+3)\left(\frac{a}{r}\right)^{n+3}+n\,(n+2)\cos^2\varphi\left(\frac{a}{r}\right)^{n+4}=2\,\Sigma\,p^2\,c_p^n\cos p\,g\,.$$

Developing the left member of this equation according to the mean anomaly, and making the coefficient of $\cos p\,g$ equal to one another, we obtain

$$n\,(n+1)\,c_p^{n+2}-n\,(2n+3)\,c_p^{n+3}+n\,(n+2)\cos^2\varphi\,c_p^{n+4}=p^2\,c_p^n\,,\tag{1}$$

an equation which was deduced by Bessel.* This serves for the verification of our values already given for c_p^n, inasmuch as the substitution of these renders the equation identical.

Passing now to the differentiation according to φ, we have

$$n\cos^2\varphi\left(\frac{a}{r}\right)^{n+2}-n\left(\frac{a}{r}\right)^{n+1}=2\operatorname{tg}\varphi\,\Sigma\frac{d\,c_p^n}{d\phi}\cos p\,g\,,$$

and after development, according to the mean anomaly,

$$n\cos^2\varphi\,c_p^{n+2}-n\,c_p^{n+1}=\operatorname{tg}\varphi\,\frac{d\,c_p^n}{d\phi}\,.\tag{2.}$$

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* *Abhandlungen der Berliner Akademie*, 1824, p. 28.

A repetition of the differentiation gives

$$n\,(n+1-2\sin^2\varphi)\,c_p^{n+2}-n\,(2\,n+3)\cos^2\varphi\,c_p^{n+3}+n\,(n+2)\cos^4\varphi\,c_p^{n+4}=\operatorname{tg}\varphi\,\frac{d}{d\,\phi}\left(\operatorname{tg}\varphi\,\frac{d\,c_p^n}{d\,\phi}\right).$$

Here we are enabled to simplify, by availing ourselves of the relation already in (1) found to exist between the coefficients c with different upper indices, and thus obtain without any difficulty

$$p^2\cos^2\varphi\,c_p^n+n\,(n-1)\sin^2\varphi\,c_p^{n+2}=\operatorname{tg}\varphi\,\frac{d}{d\,\phi}\left(\operatorname{tg}\varphi\,\frac{d\,c_p^n}{d\,\phi}\right),\ \text{or}\ p^2\frac{\cos^4\phi}{\sin^2\phi}\,c_p^n+n\,(n-1)\cos^2\varphi\,c_p^{n+2}=\frac{1}{\sin\phi\cos\phi}\,\frac{d\,c_p^n}{d\,\phi}+\frac{d^2\,c_p^n}{d\,\phi^2}.\qquad(3)$$

We may give to this equation (*aux différences melées*) a somewhat different form through the elimination of c_p^{n+2} by means of the formula (2), and thus obtain

$$p^2\frac{\cos^4\phi}{\sin^2\phi}\,c_p^n+n\,(n-1)\,c_p^{n+1}=\left(\frac{1}{\sin\phi\cos\phi}-(n-1)\operatorname{tg}\varphi\right)\frac{d\,c_p^n}{d\,\phi}+\frac{d^2\,c_p^n}{d\,\phi^2}.\qquad(4)$$

In order to avoid in this equation the factor $\frac{\cos^4\phi}{\sin^2\phi}$ with which $p^2\,c_p^n$ is multiplied, let us in the first place, by means of the differential equation

$$\frac{d\,x}{d\,\phi}=\frac{\cos^2\phi}{\sin\phi},$$

introduce a new variable x. Then by an easy transformation we shall have the equation

$$p^2\,c_p^n+n\,(n-1)\frac{\sin^2\phi}{\cos^4\phi}\,c_p^{n+1}=-n\,\frac{\sin^2\phi}{\cos^3\phi}\,\frac{d\,c_p^n}{d\,x}+\frac{d^2\,c_p^n}{d\,x^2}.\qquad(5)$$

By means of the same substitution the equation (2) will be transformed into

$$n\cos^2\varphi\,c_p^{n+2}-n\,c_p^{n+1}=\cos\varphi\,\frac{d\,c_p^n}{d\,x}.\qquad(6)$$

In order now to remove from (5) the term with which the first differential coefficient $\frac{d\,c_p^n}{d\,x}$ is multiplied, let us make

$$v_n=\cos^{\frac{3}{2}}\varphi\,c_p^n,$$

which furnishes without difficulty the equations

$$\frac{d^2\,v_n}{d\,x^2}=p^2\,v_n+\frac{n\sin^2\phi}{4\cos^6\phi}\Big[(n-6)-(n-2)\cos^2\varphi\Big]\,v_n+\frac{n\,(n-1)\sin^2\phi}{\sqrt{\cos\varphi}\,\cos^4\phi}\,v_{n+1}\qquad(7)$$

and

$$n\,v_{n+2}-n\cos^{-\frac{3}{2}}\varphi\,v_{n+1}=\frac{n}{2}\,\frac{\sin^2\phi}{\cos^3\phi}\,v_n+\frac{d\,v_n}{d\,x}.\qquad(8)$$

4. Before proceeding to any farther transformation of these equations, let us consider the special cases for which the term of equation (7) multiplied by v_{n+1} will vanish. Since $v_0=0$, this will be the case for $n=1$ and $n=-1$, and we shall have simply

$$\frac{d^2\,v_1}{d\,x^2}=p^2\,v_1+\frac{\sin^2\phi\,(\cos^2\phi-5)}{4\cos^6\phi}\,v_1$$

$$\frac{d^2\,v_{-1}}{d\,x^2}=p^2\,v_{-1}+\frac{\sin^2\phi\,(7-3\cos^2\phi)}{4\cos^6\phi}\,v_{-1}.$$

In order to integrate these equations for the case in which p denotes a large number, let us make use of the process * indicated by Hansen, and start from the forms

$$v_1=u_1\,e^{p\,x}+u'_1\,e^{-p\,x}\ ;\quad v_{-1}=u_{-1}\,e^{p\,x}+u'_{-1}\,e^{-p\,x},$$

in which u and u' denote two functions which are to be determined, and which become reduced to arbitrary constants, so soon as p increases beyond limit, because in this case all the terms not multiplied by p, in the right hand member of the equations to be integrated, will disappear, and the complete integrals of $\frac{d^2\,v_1}{d\,x^2}=p^2\,v_1$ and $\frac{d^2\,v_{-1}}{d\,x^2}=p^2\,v_{-1}$ be represented under the forms above mentioned. And we may readily perceive that by virtue of the arbitrary constants contained in u'_1 and u'_{-1}, both quantities must disappear. For since

$$x=\int\frac{\cos^2\phi}{\sin^2\phi}\,d\,\varphi=\cos\varphi+\log\operatorname{tg}\tfrac{1}{2}\,\varphi,$$

the terms multiplied by $e^{-p\,x}$ would become infinite for $\varphi=0$, while the value of c_p must vanish together with the eccentricity. Putting therefore $u'=0$, and substituting

$$v_1=u_1\,e^{p\,x},\quad v_{-1}=u_{-1}\,e^{p\,x},$$

in the complete differential equations, for v_1 and v_{-1}, we shall find

$$\frac{d^2\,u_1}{d\,x^2}+2\,p\,\frac{d\,u_1}{d\,x}=\frac{\sin^2\phi\,(\cos^2\phi-5)}{4\cos^6\phi}\,u_1,$$

$$\frac{d^2\,u_{-1}}{d\,x^2}+2\,p\,\frac{d\,u_{-1}}{d\,x}=\frac{\sin^2\phi\,(7-3\cos^2\phi)}{4\cos^6\phi}\,u_{-1}.$$

If h_1 and h_{-1} denote the constants to which u_1 and u_{-1} are reduced for $p=\infty$, we may put

$$u_1=h_1\left(1+\frac{a_1}{p}+\frac{a_2}{p^2}+\ldots\ldots\right);\quad u_{-1}=h_{-1}\left(1+\frac{b_1}{p}+\frac{b_2}{p^2}+\ldots\ldots\right).$$

For determining the coefficients a and b as functions of x, we easily obtain by development, according to decreasing powers of p, the differential equations

$$\frac{d^2\,a_m}{d\,x^2}+2\,\frac{d\,a_{m+1}}{d\,x}=\frac{\sin^2\phi\,(\cos^2\phi-5)}{4\cos^6\phi}\,a_m,$$

$$\frac{d^2\,b_m}{d\,x^2}+2\,\frac{d\,b_{m+1}}{d\,x}=\frac{\sin^2\phi\,(7-3\cos^2\phi)}{4\cos^6\phi}\,b_m,$$

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* *Abhandl. der königl. Sächsischen Gesellschaft*, II. p. 202 and ff.

which may be integrated with the greatest ease for successive values of m. To accomplish this in the most convenient manner, we introduce $y = \frac{1}{\cos\phi}$ as a new variable, and since

$$\frac{dy}{d\phi} = \frac{\sin\phi}{\cos^2\phi}\,; \quad \frac{dx}{d\phi} = \frac{\cos^2\phi}{\sin\phi}\,; \quad \frac{dy}{dx} = \frac{\sin^2\phi}{\cos^4\phi}\,; \quad \frac{d^2 y}{dx^2} = 2\,\frac{\sin^2\phi}{\cos^7\phi}(2-\cos^2\varphi)\,,$$

we obtain

$$\frac{d a_{m+1}}{dy} = \tfrac{1}{8}(1-5y^2)\,a_m + (y-2y_3)\frac{d a_m}{dy} + \tfrac{1}{2}(y^2-y^4)\frac{d^2 a_m}{dy^2}$$

$$\frac{d b_{m+1}}{dy} = -\tfrac{1}{8}(3-7y^2)\,b_m + (y-2y^3)\frac{d b_m}{dy} + \tfrac{1}{2}(y^2-y^4)\frac{d^2 b_m}{dy^2}.$$

By putting here $m = 0$, we have $a_0 = b_0 = 1$,

$$\frac{d a_1}{dy} = \tfrac{1}{8}(1-5y^2)\,,\ \text{consequently}\ a_1 = \tfrac{1}{8}(y-\tfrac{5}{3}y^3)\,,$$

$$\frac{d b_1}{dy} = -\tfrac{1}{8}(3-7y^2)\,,\quad \text{“}\quad b_1 = -\tfrac{1}{8}(3y-\tfrac{7}{3}y^3).$$

By using these values, we further obtain for $m = 1$

$$\frac{d a_2}{dy} = \tfrac{9}{64}\,y - \tfrac{77}{48}\,y^3 + \tfrac{385}{192}\,y^5\,; \qquad \text{consequently}\ a_2 = \tfrac{1}{64}(\tfrac{9}{2}y^2 - \tfrac{77}{3}y^4 + \tfrac{385}{18}y^6)\,,$$

$$\frac{d b_2}{dy} = -\tfrac{15}{64}\,y + \tfrac{33}{16}\,y^3 - \tfrac{455}{192}\,y^5\,; \qquad \text{“}\qquad b_2 = -\tfrac{1}{64}(\tfrac{15}{2}y^2 - 33\,y^4 + \tfrac{455}{18}y^6)\,,$$

which process may be continued to any desired extent. The final substitution of the results obtained gives

$$c_p^1 = h_1 \cos^{-\frac{1}{2}}\varphi\ \mathrm{tg}^p\tfrac{1}{2}\varphi\ e^{p\cos\varphi}\left\{1 + \frac{1}{8p\cos\phi}\left(1-\frac{5}{3\cos^2\phi}\right) + \frac{7}{64p^2\cos^2\phi}\left(\frac{9}{14} - \frac{11}{3\cos^2\phi} + \frac{55}{18\cos^4\phi}\right)\cdots\cdots\right\},$$

$$c_p^{-1} = h_{-1} \cos^{\frac{1}{2}}\varphi\ \mathrm{tg}^p\tfrac{1}{2}\varphi\ e^{p\cos\varphi}\left\{1 - \frac{3}{8p\cos\phi}\left(1-\frac{7}{9\cos^2\phi}\right) - \frac{15}{64p^2\cos^2\phi}\left(\frac{1}{2} - \frac{11}{5\cos^2\phi} + \frac{91}{54\cos^4\phi}\right)\cdots\cdots\right\},$$

expressions which coincide perfectly with the values previously given, if for determining the constants we put

$$h_1 = \frac{1}{\sqrt{2p\pi}}\,; \quad h_{-1} = -\frac{1}{\sqrt{2p^3\pi}}.$$

5. We now return to the general case of equations (7) and (8), and for the determination of v_n will deduce a linear differential equation of the fourth order, which is obtained from (7) by the elimination of v_{n+1}. The special equation which we have just been considering, and for which a differential equation of the second order sufficed, shows us how to proceed most conveniently. We next again put

$$v_n = u_n\, e^{px}\,,$$

and obtain by differentiation, if at the same time $y = \frac{1}{\cos\phi}$ is again introduced as variable,

$$\frac{d v_n}{dx} = e^{px}\left\{p\,u_n + \sin^2\varphi\, y^4 \frac{d u_n}{dy}\right\},$$

$$\frac{d^2 v_n}{dx^2} = e^{px}\left\{p^2 u_n + 2\sin^2\varphi\,(2y^3 - y + p)\,y^4 \frac{d u_n}{dy} + \sin^2\varphi\,(y^8-y^6)\frac{d^2 u_n}{dx^2}\right\}.$$

Transforming with these the equations (7) and (8), we have

$$(y^4-y^2)\frac{d^2 u_n}{dy^2} + 2(2y^3-y+p)\frac{d u_n}{dy} - \frac{n}{4}\Big[(n-6)\,y^2 - (n-2)\Big]u_n = n\,(n-1)\sqrt{y}\,u_{n-1} \tag{9}$$

and

$$u_{n+2} = y^{\frac{3}{2}}\,u_{n+1} + \frac{1}{2_n}\Big[n\,(y^3-y)+2p\Big]u_n + \frac{1}{n}(y^4-y^2)\frac{d u_n}{dy}. \tag{10}$$

By writing $n+1$ in the place of n, equation (9) assumes the form

$$(y^4-y^2)\frac{d^2 u_{n+1}}{dy^2} + 2(2y^3-y+p)\frac{d u_{n+1}}{dy} - \frac{n+1}{4}\Big[(n-5)\,y^2 - (n-1)\Big]u_{n+1} = n\,(n+1)\sqrt{y}\,u_{n+2}\,,$$

and substituting in this the value of u_{n+2} just obtained,

$$(y^4-y^2)\frac{d^2 u_{n+1}}{dy^2} + 2(2y^3-y+p)\frac{d u_{n+1}}{dy} - \frac{n^2-1}{4}(5y^2-1)\,u_{n+1} =$$

$$= (n+1)(y^4-y^2)\sqrt{y}\,\frac{d u_n}{dy} + \frac{n+1}{2}\Big[n\,(y^3-y)+2p\Big]\sqrt{y}\,u_n. \tag{11}$$

Here the elimination of u_{n+1} and its differential coefficients is only to be effected in the left-hand member of the equation, and offers no difficulty, inasmuch as we have already obtained in equation (9) the values of u_{n+1} in terms of u_n, $\frac{d u_n}{dy}$ and $\frac{d^2 u_n}{dy^2}$. The computation will lead to a linear differential equation of the fourth order, and of the form

$$0 = (a\,y + a_1 p)\,u_n + (b\,y^2 + b_1 p\,y + b_2 p^2)\frac{d u_n}{dy} + (5y^3 + c_1 p\,y^2 + c_2 p^2 y)\frac{d^2 u_n}{dy^2} + (d\,y^4 + d_1 p\,y^3)\frac{d^3 u_n}{dy^3} + e\,y^5\frac{d^4 u_n}{dy^4}, \tag{12}$$

in which the coefficients a, b, c, d, e, a_1, b_1, c_1, d_1, b_2, c_2, are given by the equations

$$
\begin{aligned}
a &= \frac{n(n-2)}{32}\left\{3\,(n^2+12\,n+32)\,y^4-2\,(n^2+10\,n+24)\,y^2-n^2\right\}\\
b &= \tfrac{1}{3}\left\{(4\,n^3+2\,y\,n^2-46\,n-240)\,y^4-2\,(2\,n^3+11\,n^2-20\,n-34)\,y^2+(3\,n^2-2\,n-8)\right\}\\
c &= \tfrac{1}{4}\left\{3\,(n^2-n-40)\,y^4-4\,(n^2-n-31)\,y^2+(n^2-n-20)\right\}\\
d &= -\tfrac{1}{2}\,(15\,y^4-22\,y^2+7)\\
e &= -\tfrac{1}{2}\,(y^4-2\,y^2+1)\\
a_1 &= \frac{n\,(n-2)}{8}\left\{(4\,n+11)\,y^2+1\right\}\\
b_1 &= \tfrac{1}{2}\left\{(3\,n^2-3\,n-20)\,y^2-(n^2-n-2)\right\}\\
c_1 &= -\tfrac{3}{8}\,(7\,y^2-3)\\
d_1 &= -2\,(y^2-1)\\
b_2 &= 1\\
c_2 &= -2.
\end{aligned}
$$

Putting now

$$u_n = w_0+\frac{w_1}{p}+\frac{w_2}{p^2}+\frac{w_3}{p^3}+\dots..$$

and arranging according to descending powers of p, we shall have, by virtue of (12), for any desired index m, the differential equation

$$2\,y\,\frac{d^2\,w_{m+2}}{d\,y^2}-\frac{d\,w_{m+2}}{d\,y}=a\,w_m+b\,\frac{d\,w_m}{d\,y}+c\,\frac{d^2\,w_m}{d\,y^2}+d\,\frac{d^3\,w_m}{d\,y^3}+e\,\frac{d^4\,w_m}{d\,y^4}+a_1\,w_{m+1}+b_1\,\frac{d\,w_{m+1}}{d\,y}+c_1\,\frac{d^2\,w_{m+1}}{d\,y^2}+d_1\,\frac{d^3\,w_{m+1}}{d\,y^3}.$$

From this the functions w_m must be deduced for the successive values of m. For the determination of w_0 we obtain

$$2\,y\,\frac{d^2\,w_0}{d\,y^2}-\frac{d\,w_0}{d\,y}=0\,,$$

and therefore by integration with two arbitrary constants,

$$w_0 = h_n + k_n\,y^{\frac{3}{2}}\,.$$

If we proceed to w_1, we have to integrate

$$2\,y\,\frac{d^2\,w_1}{d\,y^2}-\frac{d\,w_1}{d\,y}=a_1\,w_0+b_1\,\frac{d\,w_0}{d\,y}+c_1\,\frac{d^2\,w_0}{d\,y^2}+d_1\,\frac{d^3\,w_0}{d\,y^3}.$$

The right-hand member contains after the substitution of w_0 only terms of the form $\lambda\,y^\mu$; but it is easily found that the complete integral of the equation

$$2\,y\,\frac{d^2\,w}{d\,y^2}-\frac{d\,w}{d\,y}=\lambda\,y^\mu$$

may be represented by

$$w = h+k\,y^{\frac{3}{2}}+\frac{\lambda}{(\mu+1)\,(2\,\mu-1)}\,y^{\mu+1}\,.$$

And since the constants h and k will therefore be merged in those already contained in w_0, it will be necessary to introduce no new constants, and we obtain

$$w_1 = h_n\,\frac{n\,(n-2)}{8}\left\{\frac{4\,n+11}{9}\,y^3-y\right\}+k_n\,y^{\frac{3}{2}}\,\frac{n-3}{8}\left\{\frac{4\,n^2+33\,n+59}{27}\,y^3-\frac{5\,n+11}{5}\,y\right\}.$$

This process of integration may be continued as long as desired, and, without any other difficulty than that arising from the length of the computation, will lead to the equation

$$w_2 = h_n\,\frac{n\,(n-2)\,(n-4)}{64}\,y^2\,(2)+k_n\,y^{\frac{3}{2}}\,\frac{(n\;3)\,(n-5)}{320}\,y^2\,,\qquad [2]$$

in which for (2) and [2] we shall find the same values which were given for them at the commencement of this paper.

6. Since the value of u_n has been found by means of the integration of a differential equation of the fourth order, we must have four arbitrary constants if the integration is to be complete. Yet we have apparently only two, h_n and k_n. But it is to be remarked, that, precisely as in the special case for $n = \pm\,1$, before considered, we ought in fact to have put

$$v_n = u_n\,e^{p\,x}+u'_n\,e^{-p\,x}\,,$$

in which we should have found the same equations for the determination of u'_n as for u_n, with the sole difference that p would everywhere have had the reverse sign. This follows immediately from the circumstance that the equations (7) and (9) contain only even powers of p. — And we furthermore find

$$u'_n = w'_0-\frac{w'_1}{p}+\frac{w'_2}{p^2}-\frac{w'_3}{p^3}\pm\dots..$$

in which the functions w' only differ from the coefficients w in their two different arbitrary constants h'_n and k'_n. The reason now for which the terms multiplied by these two constants have been entirely neglected, is to be found, as before, in the circumstance that these contain the factor $e^{-p\,x}$, which increases beyond limit as the eccentricity vanishes. Since this case cannot occur, we must have $h'_n = k'_n = 0$.

The determination of the constants h_n and k_n alone remains. This is, indeed, attended with peculiar difficulties, as will be evident from the following considerations. As already mentioned, we might add, in determining the functions w_1, w_2, terms of the form $h+k\,y^{\frac{3}{2}}$, without committing any error in the integration, which exert at the same time an influence upon the values of all the following coefficients w, so that totally different determinations would be obtained for these functions. It is by all means necessary that such new additional constants should be capable of combination with the two essential, h_n and k_n; but it is manifest, at the same time, that, by every such change in the manner of integration, the values of these two constants become changed also. These depend, therefore, essentially upon the form in which the successive integrations are effected, and we can only assert that, *if in the determination of the coefficients* w_1, w_2, ... *no terms of the form* $h + k\,y^{\frac{3}{2}}$ *have been admitted*, the values of the constants h_n and k_n are fixed by the equations

$$h_n = p^{\frac{n-2}{2}}\, 2^{-\frac{n}{2}}\, \frac{1}{\Gamma\frac{n}{2}}\,; \qquad k_n = p^{\frac{n-3}{2}}\, 2^{-\frac{n-1}{2}}\, \frac{n}{\Gamma\frac{n-1}{2}}\,.$$

Any method by which the demonstration of this assertion is to be accomplished must consequently seek directly to create the given form of the functions w; or, in other words, it will be necessary to go through the whole development again in some more direct way. — As was mentioned in the commencement of this article, a method of this kind may be found, which is not only strictly rigorous, but also competent to lead to results far more general than are contained in the preceding discussion. The theorems referred to shall not fail of publication, and appear all the more desirable inasmuch as they seem to be applicable to the development of the perturbative function according to the mean anomaly A.

7. In conclusion, a numerical illustration of the formulas here given may be appropriate. For this purpose we select the computation of the same coefficients, belonging to the equation of the center, whose value was deduced by Bessel in his already cited memoir [*] upon the planetary perturbations. Bessel finds, namely, for $\sin\varphi = 0.35$, the coefficient of $2 \sin 4\,g$ to be $0.0072260 = 24'\,50''.47$, for which, according to our formulas, we have to compute

$$\tfrac{1}{4}\cos\varphi\, c_4^2 = \tfrac{1}{8}\left(\operatorname{tg}\tfrac{1}{2}\varphi\, e^{\cos\varphi}\right)^4 \left\{1 + \frac{\alpha}{\cos\phi\,\sqrt{4\cos\varphi}}\left[1 + \frac{1}{4\cos\phi}\left(\beta - \frac{\gamma}{\cos\phi}\right) + \frac{1}{4\cos\phi^2}\left(\delta - \frac{\epsilon}{\cos^2\phi} + \frac{\zeta}{\cos^4\phi}\right)\cdots\cdots\right]\right\},$$

in which the logarithms of the coefficients independent of p, α, β, γ, δ, ε, ζ, are to be computed once for all:

$\alpha = \frac{2}{3}\sqrt{\frac{2}{\pi}}$ $\qquad \log\alpha = 9.7258488.0$
$\beta = \frac{21}{40}$ $\qquad \log\beta = 9.7201593.0$
$\gamma = \frac{47}{72}$ $\qquad \log\gamma = 9.3147653.6$
$\delta = \frac{543}{896}$ $\qquad \log\delta = 9.7824918.2$
$\varepsilon = \frac{127}{64}$ $\qquad \log\varepsilon = 0.2976237.47$
$\zeta = \frac{1601}{1152}$ $\qquad \log\zeta = 0.1429388.53$

It will easily be perceived, that for a value so small as $p = 4$, and after neglecting all the terms divided by $(p\cos\varphi)^{\frac{7}{2}} = 102$, no great precision can be anticipated. Nevertheless our example shows that, even in a case so unfavorable, our formulas afford no small approximation to the true value. The computation itself, carried out with five decimals, is as follows: —

$\sin\varphi$	9.54407	ε	0.29762	ζ	0.14294	α	9.72585
$\varphi =$	$20°\ 19'\ 14''$	$-\cos^2\varphi$	$9.94324n$	$\cos^4\varphi$	9.88648	$\cos\varphi$	9.97162
$\cos\varphi$	9.97162	γ	9.81477		0.25646	4	0.60206
$\log e$	9.63778		$9.87153n$		+0.12573		0.57368
	9.60940		−0.53123	δ	9.78249		0.28634
$e^{\cos\varphi}$	0.40682	β	9.72016		0.47397		9.75423
$\operatorname{tg}\frac{1}{2}\varphi$	9.25699		0.15137		0.38219		9.46739
	9.66381		$9.34030n$		−1.20748		
	3.65524	$\frac{1}{4\cos\phi}$	9.42632	$\frac{\epsilon}{\cos^2\phi}$	0.35438		+1
$\frac{1}{8}$	9.09691						+0.29335
u	0.10698		9.46739		0.02781		−0.01714
	7.35913		$8.23401n$		9.17471		+0.00312
	5.31443			$\frac{1}{16\cos^2\phi}$	8.85264		$+1.27933 = u$
	3.17356				9.46739		
	$1491''.3$				7.49174		

Result, $0.00723 = 24'\ 51''$.

Gotha, March, 1856.

W. SCHEIBNER.

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[*] *Abhandlungen der Berliner Akademie*, 1824, p. 45.

OBSERVATIONS OF EGERIA, URANIA, THETIS, AND ISIS.

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By JAMES FERGUSON.

[Communicated by Lieutenant MAURY. — Corrected for refraction.]

EGERIA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉛ — * Δα	㉛ — * Δδ	㉛'s apparent α	㉛'s apparent δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1855, Oct. 26	15 15 28.8	4	B. Z. 349, 86	+0 37.47	— 5 13.50	9 56 5.94	+28 50 23.71
28	16 4 10.7	6	" 349, 87	+3 16.83	+12 15.74	9 59 35.19	28 45 23.62
1856, Feb. 21	9 55 0.1	5	" 499, 133	+1 17.74	+ 6 12.23	10 52 20.24	36 0 21.65
22	9 37 8.5	10	" 499, 133	+0 9.99	+ 9 11.50	10 51 12.51	36 3 21.04
24	8 23 57.6	3	" 499, 130	+1 12.27	+18 1.43	10 48 59.06	36 8 14.28
Mar. 3	9 42 29.4	7	" 499, 121	+1 35.03	— 8 50.38	10 39 53.87	36 14 44.66
5	8 40 41.3	8	" 499, 121	—0 35.31	—10 45.87	10 37 43.56	36 12 49.35
6	8 49 55.4	4	" 499, 121	—1 41.68	—12 13.66	10 36 37.20	36 11 21.72
7	8 4 20.5	10	" 499, 117	+0 59.61	+ 1 45.24	10 35 23.87	36 9 29.40
10	7 54 12.8	13	" 499, 114	+0 20.90	—12 41.94	10 32 16.12	+36 1 46.31

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
B. Z. 349, 86	9	9 55 43.93	+28 54 20.60	Bessel's Zones.
" 349, 87	8	9 56 33.77	28 31 21.16	
" 499, 133	9	10 51 13.98	35 52 58.72	α Bessel's Zones ; δ W. Mural, Prof. Yarnall.
" 499, 130	9	10 17 58.27	35 49 1.74	" " "
" 499, 121	8.9	10 38 30.42	36 22 23.18	" " "
" 499, 117	9	10 34 35.83	36 6 31.90	Bessel's Zones.
" 499, 114	8.9	10 32 6.89	+36 13 15.75	"

URANIA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㉚ — * Δα	㉚ — * Δδ	㉚'s apparent α	㉚'s apparent δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1856, Jan 18	9 27 13.1	10	Rümker 2699	—1 9.87	+ 6 10.69	8 47 29.42	+18 8 3.11
Feb. 9	9 11 35.6	7	B. Z. 274, 3	+0 4.87	+ 5 38.52	8 24 9.54	19 10 52.16
10	9 27 25.0	12	" 274, 3	—0 52.13	+ 7 55.72	8 23 12.54	19 13 9.36
17	8 27 25.8	6	" 277, 179	+0 44.97	—11 41.68	8 17 18.10	19 26 20.52
17	8 27 43.1	5	" 277, 185	—1 30.77	—17 11.42	8 17 17.66	19 26 14.89
18	7 59 17.7	10	" 277, 179	+0 1.09	—10 9.42	8 16 34.20	19 27 52.97
20	8 12 24.9	8	" 277, 179	—1 23.68	— 7 23.77	8 15 9.42	+19 30 38.50

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Rümker 2699	7	8 48 51.73	+18 0 56.98	Rümker's Catalogue.*
B. Z. 274, 3	9	8 24 17.08	19 4 24.18	Bessel's Zones.
" 277, 179	9	8 16 45.61	19 37 14.32	
" 277, 185	8	8 19 0.90	+19 42 37.88	

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* This star is also B. Z. 274, 51.

THETIS.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	⑰ — *		⑰'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1856, April 13	9 29 48.6	12	Weisse XIII. 312	—0 5.23	— 1 47.36	13 19 46.19	+1 56 52.85
22	10 5 44.4	6	B. A. C. 4170	—2 24.54	— 7 1.88	13 11 59.72	2 43 28.60
25	10 22 44.8	5	Weisse XIII. 145	+0 2.28	— 1 5.00	13 9 38.22	2 55 35.62
26	9 32 50.4	10	" 145	—0 41.22	+ 2 28.59	13 8 54.72	2 59 9.25
28	9 36 48.4	5	" 145	—2 8.53	+ 8 58.65	13 7 27.42	+3 5 0.46

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XIII. 312	8.9	13 20 1.97	+1 57 37.51	Weisse's Catalogue.
B. A. C. 4470	6.7	13 14 34.75	2 49 26.59	Santini's Catalogue.
Weisse XIII. 135	9	13 9 46.43	+2 55 36.86	Weisse's Catalogue.

ISIS.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㊷ — *		㊷'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1856, July 20	9 25 47.8	8	A. Z. 208, 84	+1 43.47	—15 55.20	15 39 38.28	—19 10 49.56
21	9 52 45.6	7	" 208, 88	+0 26.65	— 1 44.94	15 40 0.11	19 17 3.26
	9 49 51.4	6	" 208, 90	—0 44.03	+ 5 25.05	15 40 0.32	—19 17 6.12

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
A. Z. 208, 84	9	15 38 6.46	—18 55 26.76	Arg. Zones, 208, and 385.
" 208, 88	8.9	15 39 44.96	19 15 50.42	
" 208, 90	8.9	15 40 55.82	—19 23 3.02	

The Asteroid is of the (10.5) magnitude.

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On the Asymptotic Values of the Coefficients in the Development of any Power of the Radius-Vector according to the Mean Anomaly, by Professor William Scheibner.

Observations of Egeria, Urania, Thetis, and Isis, made with the Filar-Micrometer of the Washington Equatorial, by James Ferguson, Esq.

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MINIMA OF *ALGOL* AND *T CANCRI.*

BY PROFESSOR FR. ARGELANDER,
DIRECTOR OF THE OBSERVATORY AT BONN.

MINIMA OF *ALGOL*, 1856–57.

THE times in the following table are mean times at Washington, and are computed with the Elements

Epoch, 1854, Oct. 8, $0^{h.}\ 12^{m.}\ 54^{s.}$ M. T. Washington.
Period, $2^{d.}\ 20^{h.}\ 48^{m.}\ 52^{s.}$,

the equation of light having been applied. Those minima which occur during the daytime, or when the star is below or too near the horizon, are not included in the table.

Date.	h.	m.	Date.	h.	m.
1856, Sept. 26	16	33.5	1856, Dec. 21	16	58.4
29	13	22.0	24	13	47.5
Oct. 2	10	10.6	27	10	36.6
5	6	59.3	30	7	25.7
16	18	13.9	1857, Jan. 13	15	31.6
19	15	2.6	16	12	20.8
22	11	51.3	19	9	10.0
25	8	40.0	22	5	59.2
28	5	28.7	Feb. 5	14	5.4
Nov. 8	16	43.9	8	10	54.7
11	13	32.7	11	7	43.9
14	10	21.6	28	12	39.4
17	7	10.5	Mar. 3	9	28.6
28	18	26.1	6	6	17.9
Dec. 1	15	15.1	23	11	13.0
4	12	4.1	26	8	2.2
7	8	53.1	Apr. 15	9	45.8
10	5	42.1	May 22	16	22.1

EPHEMERIS OF THE MINIMA OF *T CANCRI*,

Visible in Washington, 1856–57.

For this remarkable star, I have from the observations up to the end of the last year deduced the following Elements for the minimum:—

M. T. Washington.
Fundamental Epoch, 1854, June 22, $5^{h.}\ 53^{m.}\ 42^{s.} \pm 2^{m.}\ 57^{s.}$
Length of Period, $9^{d.}\ 11^{h.}\ 36^{m.}\ 54^{s.}.86 \pm 3^{s.}.47$

Three of the minima which we have observed during the last spring agree also very well with these elements. They would make the period a couple of minutes larger; nevertheless, I would not yet be disposed to make any change in the elements. — The observations made at other times than those of the minimum indicate, moreover, that this star, during the greater part of the duration of its period, shines with unchanged brightness as a star of a faint 8th magnitude, and only appears fainter during one fourteenth part of this period. It falls, namely, in about six hours to its minimum, the 10th magnitude, and in the course of about ten hours more attains its previous brightness. During these five or six hours, in which it appears fainter than the 9th magnitude, I make use of the following stars for comparison, their mean places being referred to the equinox of 1855:—

*	α	δ	Mag.
	h. m. s.	° ′	
b	8 34 50	+19 35.1	9
e	35 52	19.2	9.10
f	34 28	22.7	10
c	34 26	36.6	10
S	8 35 39	+19 33.2	Var.

The first three form with *S* a trapezium of nearly equal sides, *c* being, indeed, a little too near to *b* for convenient employment in comparison. All these stars are also noted upon HIND's *Ecliptic Charts*; — *e* being entered as of the 10th, *f* and *c* as of the 11th magnitude.

The elements given above furnish the times of the minima for the mean distance of the earth from the stars, and in order to be able to use them for other distances, an equation of light must be applied, which may be obtained from the following tables.

TABLE I.

Correction of the Argument.

Year.	Cor.	Year.	Cor.	Year.	Cor.
	d.		d.		d
1848	+0.59	1852	+0.57	1856	+0 51
1849	+0.33	1853	+0.31	1857	—0.28
1850	+0.08	1854	+0.05	1858	—0.03
1851	—0.18	1855	—0.20	1859	—0.23

TABLE II.

Equation of Light.

Date.	Cor.	Date.	Cor.	Date.	Cor.
	m. s.		m. s		m. s.
Jan. 0	—7 19	May 10	+1 56	Sept. 17	+5 34
10	7 50	20	3 17	27	4 25
20	8 7	30	4 32	Oct. 7	3 8
30	8 9	June 9	5 39	17	1 46
Feb. 9	7 56	19	6 37	27	+0 20
19	7 28	29	7 24	Nov. 6	—1 6
Mar. 1	6 47	July 9	7 58	16	2 30
11	5 53	19	8 18	26	3 49
21	4 48	29	8 25	Dec. 6	5 2
31	3 35	Aug. 8	8 18	16	6 5
Apr. 10	2 16	18	7 56	26	6 57
20	—0 53	28	7 21	36	—7 35
30	+0 32	Sept. 7	+6 33		

Bonn, 1856, *Aug.* 29.

To the mean times at Washington expressed in fractions of a day are to be added the numbers in Table I.; and Table II. is to be entered with the argument thus obtained, after subtracting one day from the argument for the months January and February of leap-years. The corrections thus obtained from Table II. are to be added, with due regard to their signs, to the computed times, in order to obtain the times as observed.

In the course of the coming autumn and winter the following minima will be observable in the United States. The dates are given in mean Washington time, and are already corrected for the equation of light.

MINIMA OF *T CANCRI.*

	h. m.		h. m.
1856, Nov. 10	18 26.7	1857, Mar. 4	13 44.8
29	17 37.9	23	13 0.6
Dec. 18	16 49.7	Apr. 11	12 16.9
1857, Jan. 6	16 2.2	30	11 33.3
25	15 15.5	May 19	10 49.7
Feb. 13	14 29.8	June 8	10 5.9

OBSERVATIONS OF LETITIA, HARMONIA, AND ISIS,

MADE WITH THE FILAR-MICROMETER OF THE WASHINGTON EQUATORIAL.

By JAMES FERGUSON.

[Communicated by Lieutenant Maury. — Corrected for refraction.]

LETITIA.

Date.	M. T. Washington.	No. of Comp.	Comparison Star.	㊴ — * $\Delta\alpha$	㊴ — * $\Delta\delta$	㊴'s apparent α	㊴'s apparent δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1856, Mar. 24	9 31 10.5	10	Weisse X. 914	—0 21.46	— 6 35.79	10 50 20.23	+10 21 32.48
25	9 47 18.6	8	" 914	—0 58.89	— 0 28.51	10 49 42.80	10 27 39.79
Apr. 6	11 3 11.1	7	" 743	+1 56.67	+11 22.55	10 43 39.41	11 29 40.68
8	9 19 44.6	10	" 743	+1 13.89	+19 11.01	10 42 56.61	11 37 29.94
13	8 39 16.1	7	" 803	—2 58.25	—12 17.97	10 41 27.93	11 54 56.35
22	9 10 56.8	2	" 781	—3 28.44	— 3 57.72	10 40 7.24	12 16 33.11
25	9 39 13.1	5	" 781	—3 32.19	+ 0 19.21	10 40 3.46	12 20 50.23
26	8 32 33.6	10	" 716	—0 32.50	—17 6.57	10 40 4.80	12 21 51.08
28	9 2 23.1	6	" 716	—0 26.20	—15 15.44	10 40 11.09	12 23 42.34
May 13	8 36 4.6	4	" 781	—0 3.30	— 1 3.50	10 43 32.16	12 19 28.72
14	9 29 11.6	10	" 781	+0 20.15	— 2 28.36	10 43 55.60	12 18 3.93
18	10 14 56.5	7	" 781	+2 2.00	— 9 11.00	10 45 37.41	12 11 21.55
19	10 51 23.2	5	" 781	+2 30.76	—11 14.14	10 46 6.16	12 9 18.47
20	8 45 28.0	11	" 822	+1 14.63	+ 4 17.04	10 46 32.33	+12 7 23.63

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㊴ — *		㊴'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
May 21	8 37 54.7	8	Weisse X. 837	+0 53.85	+ 0 38.38	10 47 2.14	+12 5 10.87
22	9 13 52.1	5	" 837	+1 25.20	— 1 42.92	10 47 33.47	12 2 49.62
28	9 11 28.4	5	" 837	+4 49.46	—17 47.77	10 50 57.67	11 46 45.12
30	8 46 48.7	10	(3)	+0 57.77	—12 14.40	10 52 12.41	11 40 38.70
June 13	9 4 49.4	5	Weisse X. 1075	+2 47.07	—12 55.99	11 2 29.74	10 46 28.94
15	9 12 44.1	8	" XI. 61	—1 4.04	— 1 30.23	11 4 9.43	10 37 22.06
20	9 5 58.7	5	" 235	—5 53.26	+15 45.66	11 8 30.41	10 13 10.20
24	8 46 38.2	8	" 235	—2 14.48	— 4 49.10	11 12 9.15	9 52 36.12
27	9 51 45.1	5	B. A. C. 3892	—3 48.80	+ 9 8.10	11 15 2.98	9 36 6.47
28	9 4 42.0	7	" 3892	—2 53.04	+ 3 48.20	11 15 58.75	9 30 46.61
July 1	9 5 40.2	12	" 3892	+0 4.13	—13 7.82	11 18 53.88	9 13 50.72
5	8 52 38.8	6	Weisse XI. 446	—3 8.96	+ 4 2.86	11 22 57.55	8 50 29.06
5	8 54 36.1	5	" 412	—1 16.82	+11 2.35	11 22 58.08	8 50 27.40
10	8 44 18.4	6	" 495	—0 28.58	+11 10.30	11 22 12.08	+ 8 19 53.11

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse X. 914	8	10 50 52.73	+10 26 57.32	Rümker's Catalogue.
" 743	6	10 41 53.91	11 17 7.01	Weisse's Catalogue.
" 803	8	10 44 37.41	12 6 2.44	" "
" 781	7.8	10 43 47.00	12 19 18.37	" "
" 716	9	10 40 48.69	12 37 45.04	" "
" 822	8.9	10 45 29.28	12 1 52.27	" "
" 837	9	10 46 19.87	12 3 18.03	" "
(3)	9	10 51 26.26	11 51 37.87	Washington Equatorial from preceding star.
Weisse X. 1075	8	10 59 54.32	10 58 8.66	Weisse's Catalogue, and Santini's Catalogue.
" XI. 61	8	11 5 25.09	10 37 35.85	Weisse's Catalogue.
" 235	7	11 14 35.24	9 56 8.24	Santini's Catalogue.
B. A. C. 3892	7.8	11 19 3.35	9 25 41.28	B. A. Catalogue.
Weisse XI. 412	8	11 24 26.49	8 38 7.80	Rümker's Catalogue.
" 446	8	11 26 18.08	8 45 8.87	Santini's Catalogue.
" 495	9	11 28 52.24	+ 8 7 25.43	Weisse's Catalogue.

HARMONIA.

Date.	M. T. Washington.	No. of Comp.	Comparison-Star.	㊶ — *		㊶'s apparent	
				Δ α	Δ δ	α	δ
	h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1856, June 18	11 9 28.9	2	Weisse XII. 736	+3 4.38	—11 25.63	12 46 26.94	—0 9 27.75
19	11 21 12.9	6	" 835	—2 0.63	— 5 51.83	12 47 4.14	0 16 14.07
20	10 19 59.0	12	" 835	—1 24.06	—12 16.68	12 47 40.70	0 22 38.87
21	9 24 40.8	4	" 835	—0 46.19	—18 45.73	12 48 18.57	0 29 7.89
24	10 7 42.1	3	" 819	+2 6.24	+ 6 8.87	12 50 24.61	0 50 17.04
28	9 47 36.9	5	" 878	+1 49.11	— 1 2.92	12 53 26.54	—1 17 6.71

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Weisse XII. 736	9	12 43 33.49	+0 0 47.51	Weisse's Catalogue.
" 835	7	12 49 15.68	—0 11 32.05	" "
" 819	8	12 48 29.31	—0 57 35.96	Rümker's Catalogue.
" 878	8	12 51 48.36	—1 19 20.06	Weisse's Catalogue.

ISIS.

Date.		M. T. Washington.	No. of Comp.	Comparison-Star.	⑫ — *		⑫'s apparent	
					$\varDelta\alpha$	$\varDelta\delta$	α	δ
		h. m. s.			m. s.	′ ″	h. m. s.	° ′ ″
1856, July	20	9 25 47.8	8	Arg. Z. 208, 84	+1 43.47	—15 55.21	15 39 38.28	—19 10 47.56
	21	9 52 45.7	7	" 208, 88	+0 26.64	— 1 41.94	15 40 0.11	19 17 3.26
	21	9 49 51.4	6	" 208, 90	—0 43.99	+ 5 25.05	15 40 0.22	19 17 6.12
	22	10 11 13.0	3	" 208, 88	+0 50.82	— 8 9.95	15 40 24.18	19 23 28.36
	22	10 23 27.1	10	" 208, 90	—0 19.81	— 1 5.41	15 40 24.40	19 23 36.56
	23	10 1 16.6	12	" 208, 90	+0 5.33	— 7 20.45	15 40 49.54	19 29 51.61
	25	9 3 53.8	7	B. A. C. 5251	—3 15.16	+ 1 38.84	15 41 45.97	19 42 31.79
Aug.	5	9 21 48.3	2	" 5281	+0 4.42	—22 23.44	15 49 22.47	20 56 16.62
	6	8 55 36.4	6	" 5278	+1 25.52	+ 0 55.93	15 50 14.69	21 3 2.86
	7	9 3 45.2	4	" 5278	+2 20.42	+ 5 55.09	15 51 9.58	21 9 53.86
	13	8 47 21.8	6	Arg. Z. 213, 5	—1 36.80	—11 23.63	15 57 13.33	—21 51 47.40

Adopted Mean Places, 1860.0, *of Comparison-Stars.*

*	Mag.	α	δ	Authority.
		h. m. s.	° ′ ″	
Arg. Z. 208, 84	8.9	15 38 6.46	—18 55 26.76	Arg. Zones.
" 208, 88	8.9	15 39 44.96	19 15 15.42	"
" 208, 90	8	15 40 55.82	19 23 3.02	"
B. A. C. 5251	4	15 45 12.81	19 41 41.11	B. A. Catalogue and Arg. Zones.
[1] " 5281	4.5	15 49 29.96	20 34 22.31	" " "
" 5287	7	15 49 1.14	21 4 27.89	B. A. Catalogue.
Arg. Z. 213, 5	9	15 59 2.23	—21 40 50.27	Arg. Zones.

August 23d. No observations have as yet been made here either of *Leucothea* or *Circe*, though the planets have been both sought for on every clear night since July 10. — J. F.

OPPOSITION-EPHEMERIS OF MELPOMENE FOR 1856.

By ERNEST SCHUBERT.

[Communicated by Commander C. H. Davis, Superintendent American Ephemeris.]

Washington Mean Midnight.

1856.		⑱ α	⑱ δ	Log △	Log r	1856.		⑱ α	⑱ δ	Log △	Log r
		h. m. s.	° ′ ″					h. m. s.	° ′ ″		
Sept.	15	2 45 15.24	+1 34 29.4	9.980866	0.254582	Sept.	20	2 46 55.09	+0 41 15.8	9.967854	
	16	45 39.72	24 11.3	9.978176			21	47 8.18	30 8.6	9.965395	0.251701
	17	46 1.98	13 42.4	9.975528	0.254603		22	47 18.95	18 53.1	9.962989	
	18	46 21.97	1 3 3.2	9.972923			23	47 27.40	+0 7 29.9	9.960638	0.251778
	19	2 46 39.68	+0 52 14.2	9.970364	0.254642		24	2 47 33.51	—0 4 0.3	9.958344	

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[1] This star in the British Association Catalogue depends on the *Hist. Céleste*, or observations of Lalande. There has probably been an error of 20 seconds in the reading of Lalande, or in the reduction to 1850. — Dr. Argelander has observed the star twice, Zones 208, 102, and 385, 116. The mean of these has been used in the present comparison.

1856.	⑱ α	⑱ δ	Log △	Log r	1856.	⑱ α	⑱ δ	Log △	Log r
	h. m. s.	° ′ ″				h. m. s.	° ′ ″		
Sept. 25	2 47 37.29	—0 15 36.8	9.956111	0.254874	Oct. 31	2 29 34.35	—6 25 32.5	9.933035	0.259795
26	47 38.74	27 19.0	9.953940		Nov. 1	28 47.14	31 5.5	9.934251	
27	47 37.89	39 6.3	9.951836	0.254988	2	28 0.23	36 14.2	9.935574	0.260237
28	47 34.74	0 50 57.9	9.949800		3	27 13.72	40 58.0	9.936994	
29	47 29.31	1 2 52.9	9.947836	0.255123	4	26 27.72	45 16.8	9.938512	0.260696
30	47 21.63	14 50.5	9.945944		5	25 42.31	49 10.4	9.940124	
Oct. 1	47 11.72	26 50.0	9.944128	0.255277	6	24 57.60	52 38.7	9.941829	0.261171
2	46 59.58	38 50.3	9.942389		7	24 13.68	55 41.6	9.943624	
3	46 45.27	1 50 50.6	9.940729	0.255450	8	23 30.65	6 58 19.2	9.945508	0.261662
4	46 28.86	2 2 50.0	9.939151		9	22 48.58	7 0 31.3	9.947479	
5	46 10.40	14 47.6	9.937658	0.255641	10	22 7.57	2 18.0	9.949535	0.262170
6	45 49.96	26 42.5	9.936254		11	21 27.70	3 39.2	9.951675	
7	45 27.55	38 33.8	9.934938	0.255851	12	20 49.02	4 35.1	9.953895	0.262694
8	45 3.22	2 50 20.5	9.933711		13	20 11.60	5 5.9	9.956193	
9	44 36.98	3 2 1.8	9.932574	0.256081	14	19 35.48	5 11.8	9.958568	0.263234
10	44 8.84	13 36.8	9.931527		15	19 0.69	4 53.1	9.961016	
11	43 38.92	25 4.4	9.930574	0.256328	16	18 27.33	4 9.9	9.963535	0.263789
12	43 7.31	36 23.8	9.929715		17	17 55.45	3 2.4	9.966123	
13	42 34.08	47 34.0	9.928954	0.256593	18	17 25.15	7 1 31.0	9.968778	0.264359
14	41 59.32	3 58 34.0	9.928297		19	16 56.50	6 59 35.8	9.971499	
15	41 23.10	4 9 23.0	9.927742	0.256878	20	16 29.53	57 17.2	9.974283	0.264944
16	40 45.49	20 0.1	9.927287		21	16 4.25	54 35.6	9.977127	
17	40 6.57	30 24.3	9.926934	0.257182	22	15 40.70	51 31.3	9.980028	0.265543
18	39 26.38	40 34.8	9.926683		23	15 18.86	48 4.8	9.982985	
19	38 45.04	4 50 30.7	9.926535	0.257501	24	14 58.82	44 16.3	9.985995	0.266157
20	38 2.64	5 0 11.1	9.926492		25	14 40.63	40 6.3	9.989056	
21	37 19.27	9 35.0	9.926554	0.257839	26	14 24.34	35 35.1	9.992165	0.266786
22	36 35.00	18 41.6	9.926724		27	14 10.01	30 43.2	9.995321	
23	35 49.95	27 30.0	9.927000	0.258195	28	13 57.63	25 31.2	9.998520	0.267428
24	35 4.22	35 59.4	9.927383		29	13 47.20	19 59.5	0.001760	
25	34 17.93	44 9.0	9.927873	0.258569	30	13 38.74	14 8.6	0.005040	0.268084
☍ 26	33 31.18	51 58.0	9.928471		Dec. 1	13 32.24	7 59.2	0.008356	
27	32 44.07	5 59 25.7	9.929176	0.258961	2	13 27.72	6 1 31.8	0.011707	0.268754
28	31 56.72	6 6 31.6	9.929985		3	13 25.17	5 54 46.9	0.015090	
29	31 9.21	13 15.0	9.930899	0.259370	4	2 13 24.61	—5 47 45.2	0.018502	0.269437
30	2 30 21.75	6 19 35.5	9.931916						

☍ 1856, October 26, 11^h. 56^m. 28^s.9, Mean Time Washington. Intensity of light = 3.738. r is the radius-vector in the ellipse 1854, Jan. 0.

APPROXIMATE EPHEMERIS FOR THE YEAR.

Mean Washington Midnight.

1856.	⑱ α	⑱ δ	Log △	Log r	1856.	⑱ α	⑱ δ	Log △	Log r
	h. m.	° ′				h. m	° ′		
Jan. 1	18 35.99	—17 34.3	0.50914	0.35321	July 9	1 14.33	+4 26.6	0.19159	0.26505
11	18 57.52	17 23.1	0.50153	0.34835	19	32.55	5 3.5	0.16208	0.26226
21	19 19.25	17 0.2	0.49849	0.34342	29	1 49.77	5 22.3	0.13140	0.25987
31	19 41.12	16 25.9	0.49104	0.33841	Aug. 8	2 5.62	5 20.4	0.09988	0.25790
Feb. 10	20 2.95	15 40.7	0.48217	0.33335	18	19.67	4 55.8	0.06789	0.25637
20	24.78	14 45.2	0.47191	0.32826	28	31.43	4 7.1	0.03598	0.25531
March 1	20 46.55	13 40.2	0.46031	0.32314	Sept. 7	40.31	2 51.3	0.00514	0.25471
11	21 8.20	12 26.6	0.44737	0.31801	17	45.82	+1 18.8	9.97683	0.25460
21	29.70	11 5.7	0.43311	0.31290	27	47.63	—0 33.3	9.95285	0.25496
31	21 51.07	9 38.6	0.41756	0.30782	Oct. 7	45.62	2 32.9	9.93557	0.25580
April 10	22 12.25	8 6.7	0.40070	0.30280	17	40.40	4 25.4	9.92708	0.25710
20	33.28	6 31.7	0.38258	0.29787	27	33.08	5 56.0	9.92881	0.25886
30	22 54.17	4 54.9	0.36319	0.29304	Nov. 6	25.28	6 51.2	9.94098	0.26105
May 10	23 14.88	3 18.3	0.34249	0.28836	16	18.70	7 4.7	9.96229	0.26365
20	35.13	1 43.7	0.32055	0.28386	26	14.50	6 38.1	9.99061	0.26662
30	23 55.82	— 0 12.9	0.29727	0.27955	Dec. 6	13.43	5 36.8	0.02371	0.26996
June 9	0 15.98	+ 1 11.8	0.27284	0.27549	16	15.63	4 9.4	0.05933	0.27361
19	35.85	2 28.2	0.24705	0.27169	26	20.87	2 24.0	0.09599	0.27755
29	0 55.37	+ 3 34.0	0.21996	0.26820	36	2 28.83	—0 27.1	0.13218	0.28173

FROM A LETTER OF PROFESSOR BRÜNNOW TO THE EDITOR.

Ann Arbor, 1856, *July* 24.

I HAVE made the following observations of *Flora* with the Meridian Circle.

1856.	Ann Arbor M. T.	⑧ α	⑧ δ
	h. m. s.	h. m. s.	° ′ ″
June 4	12 59 55.3	17 55 24.89	—18 47 48.2
9	12 35 2.4	17 50 10.66	18 55 44.1
11	12 24 59.8	17 47 59.56	18 59 7.7
28	10 59 11.4	17 28 58.62	19 32 44.3
July 1	10 44 15.9	17 25 50.25	19 39 22.7
2	10 39 19.4	17 24 49.55	—19 41 37.5

I have compared these observations with the Ephemeris in ENCKE's *Jahrbuch*, which is calculated from my tables, and found the following errors (Eph. — Obs.) : —

	$\Delta\alpha$	$\Delta\delta$		$\Delta\alpha$	$\Delta\delta$
	s.	″		s.	″
June 4	—0.04	+2.6	June 28	—0.05	+1.0
9	+0.07	+2.0	July 1	+0.12	+1.3
11	+0.01	—0.3	2	+0.10	+0.8

An observation by Mr. G. RÜMKER, in Hamburg, published in the *Astr. Nachr.*, gives the following error : —

	$\Delta\alpha$	$\Delta\delta$
	s.	″
June 10	—0.02	+2.6

The error of my tables is therefore now, after four years (the last opposition used for computing the tables was that of 1852),

$+0^{s}.027$ in α, and $+1''.4$ in δ.

F. BRÜNNOW.

OBSERVATIONS OF THE VARIABLE STARS.

IN Nos. 80 and 82 of the *Astronomical Journal* were published an article by Professor ARGELANDER on the Minima of *Algol*, — describing also the method of observation, — and an appeal to American students of astronomy to take part in these important observations, requiring as they do no apparatus or equipment beyond what is within the reach of every one. An appeal to the same effect was also made through the columns of journals more widely circulated, and it is to be hoped that some interest may have been awakened for the investigation of the strange and striking phenomena of the variable stars; and that observers may be found wherever there is a love for astronomy, and a disposition to labor for its advancement.

To the present number, Professor ARGELANDER has contributed an ephemeris of the minima visible in the United States during the coming autumn and winter, and the Editor would again earnestly appeal to all interested in astronomical science to undertake and fulfil their share of the labor, and communicate their results to him from time to time.

Professor ARGELANDER has also annexed an ephemeris of the minima of *T Cancri*, which requires a telescope or spy-glass of low power, but no other apparatus; and the number of those who possess or have access to such instruments is so very large, that the Editor cannot but entertain a sincere hope that numerous observations of the minima of this star may also be made.

In the *Astronomische Nachrichten* for Sept. 9 is also an article by Professor ARGELANDER with a discussion of the observations upon the light of the variables *α Herculis*, *δ Cephei*, *R Aquilæ*, and *χ Cygni*. The period of the former is still doubtful, and every observation is of great value. The concluded elements of the variability of the latter annexed, are in Bonn Mean Time.

δ Cephei.

Fundamental Epochs		h. m. s.	m. s.
Minima,	1840, Sept. 24,	20 42 57	± 8 45
Maxima,	1840, Sept. 26,	11 18 26	± 10 23.5
Period,	d. h. m. s. 5 8 47 39.974		

Appended to the fifteenth volume of the *Radcliffe Observations* (for 1851) is an interesting and valuable catalogue of the variable stars, their places and their periods, so far as ascertained, together with copious notes by Mr. Pogson, the well-known and zealous assistant at the Radcliffe Observatory. Mr. Pogson intimates his intention of preparing a more extended work upon the same subject.

G.

DISTRIBUTION OF ASTEROID-OBSERVATIONS.

The appeals to astronomers for a systematic distribution of the duty of observing the small planets have now met with a promptly favorable reception, and regular observations of every asteroid have been undertaken at one or more observatories.

Professor Peters has recently given in the *Astronomische Nachrichten* a table presenting for reference a view of this distribution so far as at present undertaken, and this is here reproduced for convenience. — It will be observed that the amounts of labor thus undertaken by different observatories is extremely unequal, and it is earnestly to be hoped that some of the fifteen asteroids which have as yet been undertaken by only one observatory may yet be adopted by American observers.

The Editor of the *Journal* has signified his willingness to be responsible for regular series of observations of four asteroids, and to these the word *Albany* has been affixed in the table. — It would, however, be manifestly improper to pledge the energies of an institution which has not yet commenced its active operations, even did no other considerations prohibit such a step; and the word *Albany* will therefore be interpreted as indicating the strong desire on the part of the Editor that the Dudley Observatory should immediately on entering into activity, assume its just proportion of the work; and his confidence that provision will be made for these observations at some American observatory under any circumstances.

It will be seen that, of the fifteen small planets which have been undertaken by one observatory only, there are nine which are not observed upon this continent.

No steps have as yet been taken towards the equally desirable end of distributing the labor of preparing elements and publishing ephemerides.

G.

ASTEROID-GROUP.

1856, *October* 8.

No.	Name.	Observatory.	No.	Name.	Observatory.
①	*Ceres*,	Leipsic, Rome.	㉒	*Calliope*,	Göttingen, Vienna, Ann Arbor.
②	*Pallas*,	Leipsic, Rome.	㉓	*Thalia*,	Berlin, Vienna.
③	*Juno*,	Leipsic, Rome.	㉔	*Themis*,	Cambridge (Eng.), Berlin.
④	*Vesta*,	Albany, Rome.	㉕	*Phocea*,	Washington, Berlin.
⑤	*Astrea*,	Göttingen, Vienna, Ann Arbor.	㉖	*Proserpina*,	Cambridge (Eng.), Ann Arbor.
⑥	*Hebe*,	Altona, Ann Arbor, Bilk.	㉗	*Euterpe*,	Vienna.
⑦	*Iris*,	Altona, Albany.	㉘	*Bellona*,	Cambridge (Eng.).
⑧	*Flora*,	Cambridge (Eng.), Ann Arbor.	㉙	*Amphitrite*,	Altona, Albany.
⑨	*Metis*,	Cambridge (Eng.), Ann Arbor.	㉚	*Urania*,	Cambridge (Eng.).
⑩	*Hygea*,	Altona.	㉛	*Euphrosyne*,	Berlin, Vienna, Ann Arbor.
⑪	*Parthenope*,	Altona, Bilk.	㉜	*Pomona*,	Vienna.
⑫	*Clio*,	Cambridge (Eng.), Ann Arbor.	㉝	*Polymnia*,	Berlin, Vienna.
⑬	*Egeria*,	Washington.	㉞	*Circe*,	Cambridge (Eng.), Berlin.
⑭	*Irene*,	Washington.	㉟	*Leucothea*,	Washington.
⑮	*Eunomia*,	Altona, Albany.	㊱	*Atalanta*,	Berlin, Vienna.
⑯	*Psyche*,	Washington, Berlin.	㊲	*Fides*,	Washington.
⑰	*Thetis*,	Washington.	㊳	*Leda*,	Göttingen, Vienna.
⑱	*Melpomene*,	Washington.	㊴	*Letitia*,	Altona.
⑲	*Fortuna*,	Altona.	㊵	*Harmonia*,	Vienna.
⑳	*Massalia*,	Göttingen, Vienna.	㊶	*Daphne*,	Vienna.
㉑	*Lutetia*,	Berlin, Vienna.	㊷	*Isis*,	Göttingen, Vienna.

REMARKS BY THE EDITOR.

The numbers constituting the present volume of the *Astronomical Journal* have appeared at so long intervals as to render an apology due to the subscribers, to the contributors, and to astronomers generally. Numerous circumstances, deeply regretted by the Editor, but almost entirely beyond his control, have combined to occasion delays which not unfrequently have resulted in the suppression of the article. — Successive protracted and distant journeys, without a competent substitute at home, long-continued indisposition, together with other equally serious obstacles and sources of embarrassment, have given rise to the delays in question, besides rendering the Editor unwilling to undertake the publication of extended researches, likely to find another channel.

The present number, especially, has been very long delayed, as will be perceived from the dates of the several articles. — In the full conviction that it would be the last of the series, it was too difficult to give it to the press, either with or without announcement to this effect.

To the votaries, students, and lovers of astronomy on both sides the Atlantic, whose cordial sympathy, friendly support, and valued counsel have enabled the *Astronomical Journal* to reach the close of its fourth volume, in spite of every hindrance, the Editor has now the unexpected gratification of announcing its establishment upon a new and secure basis. The unsolicited generosity of twelve gentlemen, ten of whom are citizens of Albany, has furnished the means of defraying all its expenses, — while the anticipated entrance into a new sphere of duties will, by removing the necessity for continued absence in distant parts of the republic, enable the Editor to devote to the immediate supervision of the *Journal* a care commensurate with his hopes and endeavors.

At the recent inauguration of the Dudley Observatory, it was announced by Professor Bache, at the request of the twelve gentlemen mentioned, and to the entire surprise of the Editor, that the existence and continuance of the *Astronomical Journal* would be guaranteed for a series of five volumes, in order that it might be published in connection with the Dudley Observatory. Such a guaranty appears equivalent to insuring the continuance of the *Journal* for a much longer period, provided the Editor's life is spared, inasmuch as nothing but the sternest necessity will induce him to abandon it.

The ensuing numbers will be dated from Albany, in the State of New York, although the Editor's address remains unchanged until farther notice.

Cambridge, 1856, *October* 9.

B. A. GOULD, Jr.

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